***GradeDec 2000* version 1.4**

User's Manual

Federal Railroad Administration

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Contents

Introduction

Introduction to *GradeDec 2000*

GradeDec 2000 is a decision support tool that assists federal, state and local authority decision makers in evaluating the benefits and costs of highway-rail grade crossing upgrades, separations, and closures. *GradeDec 2000* employs benefit-cost methodologies that are used to evaluate highway-rail grade crossing investment alternatives at the corridor level or in a region. *GradeDec 2000* utilizes modeling frameworks that were developed by the Volpe National Transportation Systems Center, the National Cooperative Highway Research Program and the Federal Railroad Administration. It enables the user to conduct analyses that effectively support the planning and investment decision processes.

GradeDec 2000 forecasts the transportation and non-transportation effects of highway-rail grade crossing investments and estimates the economic value of these effects over the useful life of the project in dollar terms. The benefit-cost of an investment is calculated by comparing the time-stream of expected economic benefits with the time-stream of investment-related and other costs, after adjusting for the opportunity costs of capital. Known as "discounting", this adjustment enables decision makers to inspect future benefits and costs in terms of their *present-day* value. This is a standard way of giving due weight to nearer-term versus distant (thus less valued) outcomes.

GradeDec 2000's underlying methodology is consistent with the current benefit-cost methodologies employed by the United States Department of Transportation Agencies (Federal Railroad Administration, Federal Highway Administration, Federal Transit Administration, and the Federal Aviation Administration) and with Executive Order 12866 which governs the principles of federal infrastructure investment. The model is transparent in all of its assumptions and the model inputs are readily accessible to users who may want to adjust model inputs to reflect local circumstances.

GradeDec is designed to minimize the data needs and technical expertise required of the user while at the same time providing credible benefit-cost results. With information about a series of grade crossing improvements along a particular corridor, the range of anticipated accident reductions, train crossing delay improvements, and

changes in travel demand generate preliminary benefit-cost results for a given confidence interval. Depending on the user's needs, requirements, and abilities, the user can select either an extensive default database that will minimize input requirements, or the user can customize the results by inputting project specific localized data. In this way, GradeDec will function as both a high-level preliminary model and a micro-level localized model.

Why *GradeDec 2000*

Growing requirements for highway-rail grade crossing investments and dwindling fiscal resources point to the need for a new tool for investment analysis. GradeDec determines the effects rail corridor investments will have on safety and highway delay and queuing. Improvements will result in the following economic benefits:

- Improvement in safety and reduced accident costs;
- Reduced travel time costs;
- Improved air quality
- Reduced vehicle operating costs; and
- Network benefits.

GradeDec 2000 uses risk analysis to evaluate highway-rail grade crossing investments and the results of an analysis include probability distributions for all of the model outcomes. These outcomes are viewed with *GradeDec 2000*'s user-friendly displays of charts and statistics.

For a corridor or regional analysis, *GradeDec 2000* can evaluate up to 600 grade crossings simultaneously. The user can view model results in total for the corridor or region, or by individual grade crossings. For example, the user can view the safety benefits of each grade crossing improvement along the corridor and the probability range associated with those benefits. Likewise, the user can view the highway vehicle operating costs savings or environmental benefits for each grade crossing.

GradeDec 2000 conducts comprehensive statistical simulations in order to provide a probability range for the net present value associated with each rail corridor-level investment plan. This enables the user to assess the risk associated with each plan. Additionally, GradeDec conducts sensitivity analyses based upon the probability ranges and informs the user which factors will have the greatest impact on the outcomes. For each result the user can display a "tornado chart" that shows the ten most significant factors contributing to risk. This information is essential for planning contingencies and working to mitigate risks.

GradeDec thus provides important insight for planners and decision makers in prioritizing investment plans. Two series of investments displaying an equal net present value may not offer equal promise if one exhibits a materially greater down-side risk of a low return.

In any “portfolio” there is a place for riskier investments; the important thing is to be aware of them and to chose them judiciously. GradeDec provides the management information needed to support decisions involving trade-offs between the expected return and the riskiness of investments.

New Features in *GradeDec 2000*

GradeDec 2000 includes a host of new features and these are listed here as interface and analytic improvements:

Interface Improvements

- The software is re-engineered entirely in Visual Basic 6.0 thus ensuring stability, Y2K compliance and compatibility with current and future versions of the Microsoft Windows™ operating system.
- The user interface is re-designed for ease of use and improved navigation and accessibility to data and assumptions.
- The user can custom tailor the data for each grade crossing and does not have to rely upon pre-defined grade crossing profiles.
- The risk analysis data input form now provides a choice of probability distributions - skewed bell-shaped, uniform, triangle or normal distribution.
- The new data input form enables immediate visualization of the data.
- There is a seamless import/export interface with spreadsheet programs.
- The years dimension for data inputs adjusts dynamically to the user's definition - there is no scrolling through screens of placeholder inputs.
- The number of results variables adjusts dynamically to the number of grade crossings in an analysis. The software can accommodate up to 500 custom grade crossings in an analysis.
- There is a new chart format - the Tornado Chart - that displays the top ten input variables to which the risk of a result is most sensitive.
- The model reports all benefit results by benefits category for every grade crossing, and, for the corridor as a whole.

Analytic Improvements

- The *GradeDec 2000* model includes DOT's Accident Prediction and Severity Formulas and these can be applied individually to each grade crossing so as to develop base year accident rates by type of accident.
- The model accounts for the correlation between the time-of-day distribution of traffic by rail and highway modes.

- The model re-assigns highway traffic when improvements involve closures and grade separations.
- The model calculates non-conventional, local benefits from grade crossing improvements.

GradeDec 2000 System Architecture

The diagram below presents an overview of the *GradeDec 2000* system architecture. The system is designed for ease-of-use and conceptual clarity. The design enables novice and casual users to conduct meaningful analyses with relative ease while not requiring the user to wade through technically dense material. At the same time, expert users who want to take advantage of all of the system's features should find *GradeDec 2000* useful for the comprehensive analysis of corridor-wide and regional grade-crossing improvements.

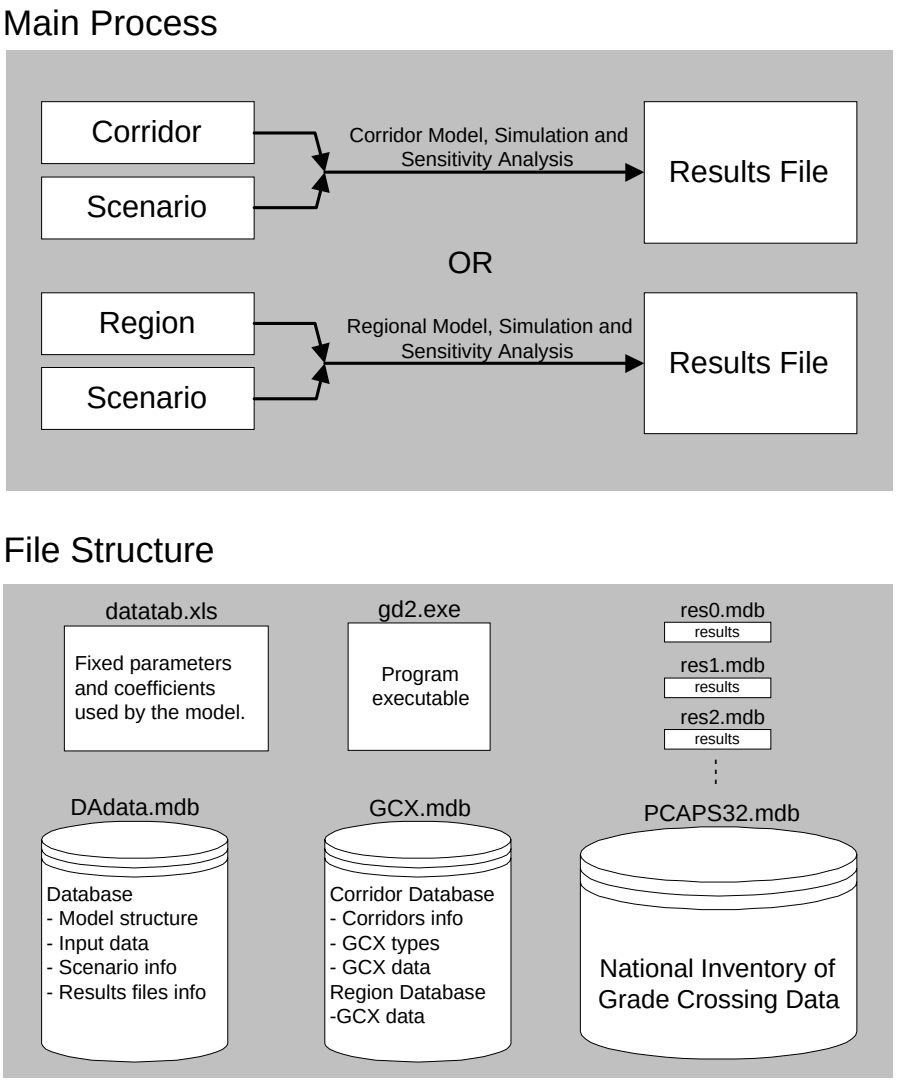

Figure 1 GradeDec 2000 *System Architecture*

GradeDec 2000 Objects

The functions of *GradeDec 2000* center around several objects that are key components in every analysis. These objects are: the *GradeDec 2000* model, corridors, scenarios and results files. When *GradeDec 2000* is active, the system will always specify instances of these objects in its **Current Selections** (see below).

The following subsections describe the *GradeDec 2000* objects.

The GradeDec 2000 *Models*

GradeDec 2000 contains two models: A corridor model and a regional model. The corridor model is suited for analyses of grade crossings along a single rail alignment. The regional model considers grade crossings in a region irrespective of their locations on rail corridors.

Each of the two *GradeDec 2000* models is a defined set of input variables, result variables and the formulas and processes that generate the results. The models themselves are deterministic, that is, for a fixed set of input values they generate a fixed set of results values. The *GradeDec 2000* Reference Manual documents the *GradeDec 2000* models.

The *GradeDec 2000* program contains a simulation engine that samples from probability ranges on the input values and runs the selected model many times to generate many sets of results in a simulation, thus producing a probability distribution for each of the result variables. (The process of sampling from input variable distributions to evaluate the probability distributions of result variables is referred in this manual as “risk analysis”, “simulation” and “Monte Carlo" or "Latin Hypercube simulation”).

When running a simulation, the selected *GradeDec 2000* model is populated with data from two sources: the corridor and scenario specified in **Current Selections**. The model results are stored in the results file specified in **Current Selections**. Probability ranges can be assigned only to scenario data.

Corridors (Corridor Model Only)

A “corridor” refers to a continuous series of highway-rail grade crossings along a rail line that are the candidates for improvements or closure.

A corridor definition includes an ID number assigned by the system, a corridor name, a technology impact factor (that determines the impact of new technology relative to conventional lights and gates), the length of the corridor in miles, the average number of trains per day and the number of switch trains, and a date/time number indicating the last modification of crossing data or corridor definition. A corridor contains at least one grade crossing and the model can accommodate up to a maximum of 600 grade crossings per corridor. Grade crossing data include the physical characteristics of the crossing, existing and proposed crossing types, crossing accident-related data and cost data.

The corridor definitions, crossing data and the crossing type definitions are stored in a database called GCX.mdb.

Regions (Regional Model Only)

A “region” refers to a collection of highway-rail grade crossings in a region that are the candidates for improvements or closure.

A region definition includes an ID number assigned by the system, a region name, a technology impact factor (that determines the impact of new technology relative to conventional lights and gates), a date/time number indicating the last modification of crossing data or region definition. A region contains at least one grade crossing and the model can accommodate up to a maximum of 600 grade crossings per region. Grade crossing data include the physical characteristics of the crossing, existing and proposed crossing types, crossing accident-related data and cost data.

The region definitions, crossing data and the crossing type definitions are stored in a database called GCX.mdb.

Note: This version of *GradeDec 2000* lets the user import data directly from FRA's National Grade Crossing Inventory database.

Scenarios

A scenario is a collection of data required for an analysis (i.e., every data element corresponds to a *GradeDec 2000* model input variable). A scenario definition includes a system assigned ID, a name, a beginning year for an analysis, an end year for an analysis, and date/time specifying the last modification of scenario data.

The data belonging to a scenario have two distinguishing features:

- Scenario data are not specific to a particular crossing or corridor (one scenario can potentially serve in the analysis of more than one corridor), and,
- The data for a model input variable in a scenario can be one of the following: 1) a fixed value, 2) two values representing the minimum and maximum points of a uniform probability distribution, or, 3) three values that describe a bell-shaped probability distribution for the input variable.

All scenario data and definitions are stored in the DAdata.mdb database.

Results Files

The results of a risk analysis simulation and a sensitivity analysis are stored in a separate database file. The results file definition includes a system assigned ID and user-specified description. When a simulation is run, the results file definition is modified to include date/time of analysis, number of trials and random seed information.

Software Installation

Follow these instructions to install the software onto your system.

1. **Install the software**

- Insert the CD-ROM in the disk drive, or, download files from the internet to a folder on your local hard drive.
- Open Windows Explorer to the folder (on the CD-ROM or your hard drive) containing the file GD2K.exe.
- Double-click on the file GD2K.exe.
- Follow the installation instructions that appear on your screen.
- If a message appears indicating that a file can not be copied because the destination file is in use, click on the Ignore button, your computer does not need this file. Installation will proceed normally after this. (The message indicating a destination file is in use and the need to click on Ignore may occur several times during installation).
- Click OK when the installation is complete.

2. **Install a database containing data from FRA's National Inventory of Highway-Rail Grade Crossings.**

- For CD-ROM, select a region on the CD-ROM in the Regions folder and double-click on the selection.
- For web download installation, double-click on the Regionx.exe (or, National.exe) file that you downloaded.
- Follow the installation instructions that appear on your screen.

3. **You are now ready to begin using the software.**

System Requirements

The hardware and software requirements to run the software are given below.

- Intel Pentium family computer running the Windows 95/98, or, Windows 2000 operating systems.
- A minimum of 16 MBytes total memory.
- Hard disk space required for installation is 15 MBytes.

Software Performance and System Hardware

Systems meeting the minimum specifications should perform most functions with near-instantaneous speed. However, the speed of a simulation on minimally configured systems may be slow.

In general, systems with more memory and faster CPUs will run simulations faster. The time to complete a simulation will depend upon a) the number of grade crossings in a region or corridor, and, b) the number of trials in a simulation.

As a benchmark, a computer with a 350 Mhertz processor and 64 Mbyte RAM will run 500 simulations with 10 grade-crossings, including sensitivity analysis, in under 25 seconds.

Manual Overview

The remainder of this document describes the steps of a *GradeDec 2000* analysis and each of the forms that are encountered during an analysis. The manual concludes with a glossary of terms and an index.

Using *GradeDec 2000*

Introduction

There are five steps in conducting a *GradeDec 2000* analysis. These are illustrated in the following figure:

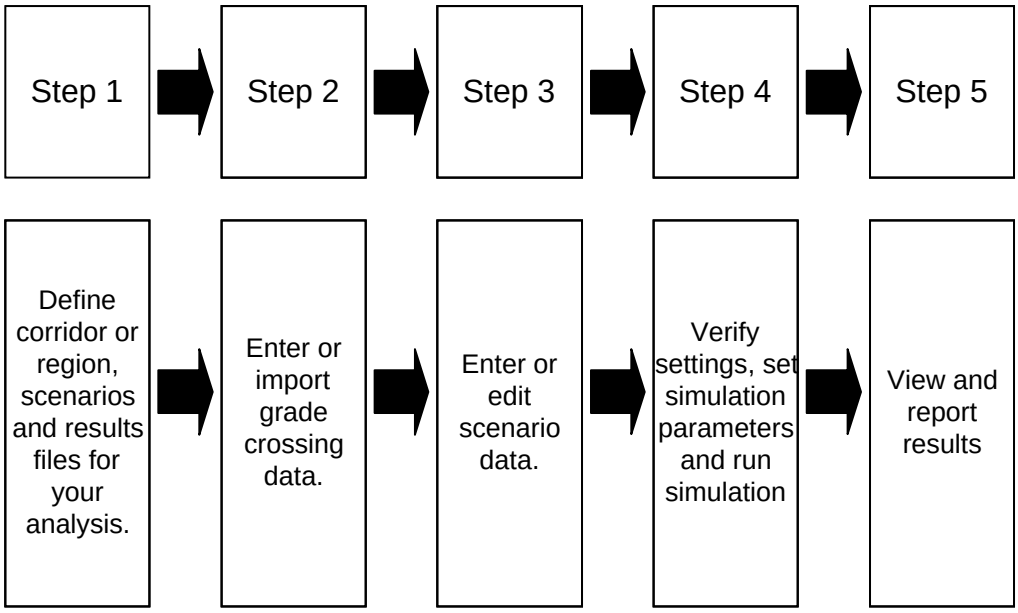

Figure 2 Steps in a GradeDec 2000 *Analysis*

The following sections will guide you through these steps.

Step 1: Define Components of Analysis

The first step of a *GradeDec 2000* analysis is to define the components of the analysis. After you define the components, you can enter data and run a simulation in the subsequent steps.

Select Model

First, you need to select either the corridor model or the regional model. The corridor model evaluates improvements along a single rail alignment and estimates impacts along the adjacent highway network. With a regional analysis, the crossings that are candidates for improvement do not need to lie on a single alignment and the model does not evaluate impacts on the adjacent highway network.

Select the model by clicking on the appropriate node of the **Object Tree** in the Main form.

Define Region or Corridor

You define a new region by double-clicking on the Regions (regional model) node or the Corridors (corridor model). When the "Modify" form pops up, press either the "New Region" or "New Corridor" button and enter the required information.

You can select a previously defined region or corridor by clicking on the region or corridor in the **Item List** on the Main form (when either the Corridor or Region node of the Main form is selected).

Define Scenario

You define a new scenario by double-clicking on the Scenarios node. When the "Modify" form pops up, press the "New Scenario" button and enter the required information.

You can select a previously defined scenario by clicking on the scenario in the **Item List** on the Main form (when the Scenario node of the Main form is selected).

Define Results File

You define a new results file by double-clicking on the Results files node. When the "Modify" form pops up, press the "New Results File" button and enter the required information.

You can select a previously defined Results File by clicking on the results file in the **Item List** on the Main form (when the Scenario node of the Main form is selected).

Step 2: Enter or Import Grade Crossing Data

You enter grade crossing data for a pre-defined region or corridor by invoking the Corridor Crossing Data form (Corridor Model) or the Regional Crossing Data form (Regional Model). You invoke these forms by double-clicking on the selected region or corridor in the **Item List** of the Main form.

The Regional Model currently enables importing data from the National Inventory of Grade Crossings database. This feature will be added to the Corridor Model in future versions of *GradeDec 2000*.

See the sections on the forms mentioned above for instructions on data entry and management.

The grade crossing data forms (corridor and region) have menu options that enable you to generate graphs that rank risks at crossings in the base case and the alternate case. There are also menu options for generating reports of the grade crossing data.

Step 3: Enter or Edit Scenario Data

Scenarios include data related to rail operations in the corridor or region, highway traffic, social costs and price growth rates. The Scenario Data Input form allows for the probability ranges to reflect uncertainty (or variability) in each of the inputs. See the section on the Scenario Data Input form for instructions.

Step 4: Verify Settings, Set Parameters and Run Simulation

Verify Settings

Verify the settings by viewing the selections in the **Current Selections** at the top of the Main form. If you need to change settings:

- Select a node of the **Object Tree** (either "Corridors", "Scenarios" or "Results files"). Selecting the node shows a listing of the selected object in the **Item List**.
- Select an item in the **Item List**. The selected item will appear in the Current Selections.

Set Parameters and Run Simulation

From the menu on the Main form, select Simluation>Run a simulation. This will invoke the Simulation form. Set the parameters on the form and click on the Run Simulation button. For detailed instructions, see the Simulation form section.

Step 5: View and Report Results

Use the Results form and the Full-Screen Charts and Tornado Charts forms to view and report your results. These forms allow for easy navigation and printing. Results data can be exported to an MS Excel spreadsheet (see the Results Form section, "Export and Print").

Forms in *GradeDec 2000*

Introduction - Key to Forms

The figure to the right shows an hierarchy of all the forms in *GradeDec 2000* and a reference number for each form. The reference number indicates a section providing complete instructions for the form.

The remainder of this chapter contains a section for each form describing the form, its purpose and function, and the data elements associated with it.

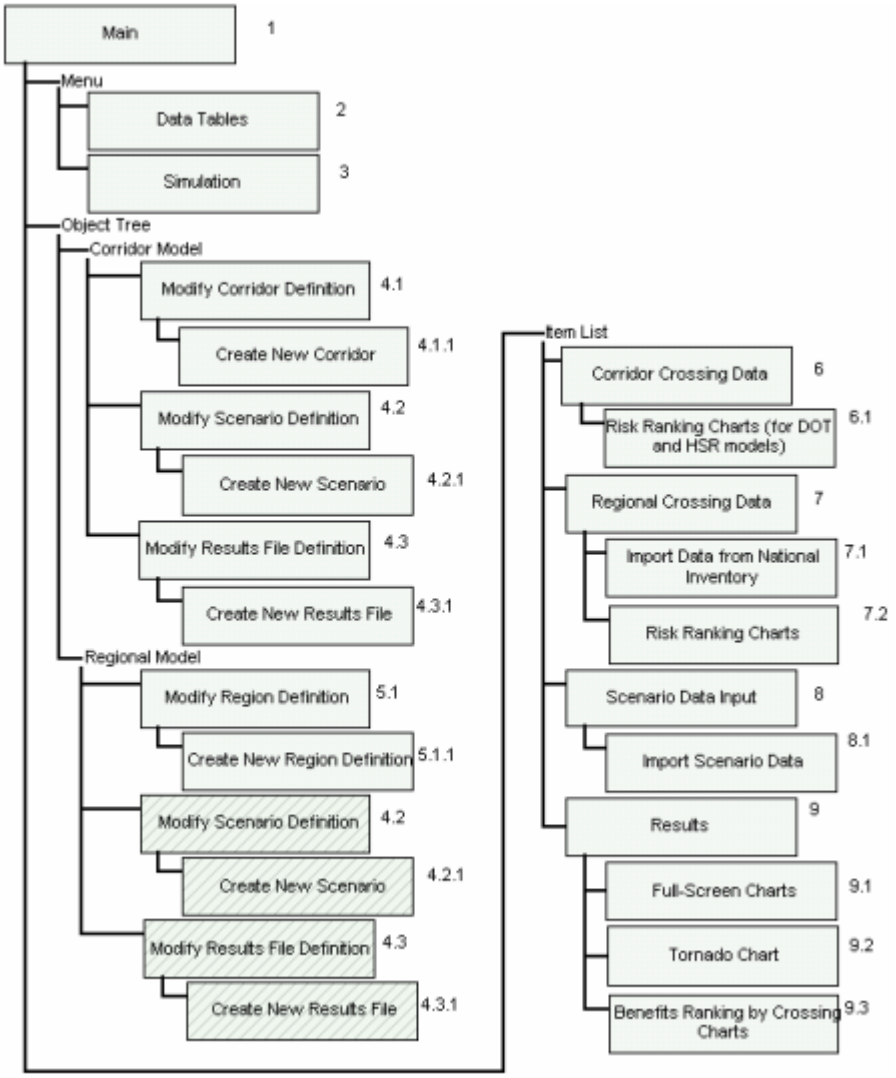

Figure 3 Key to Forms

The Main Form (1)

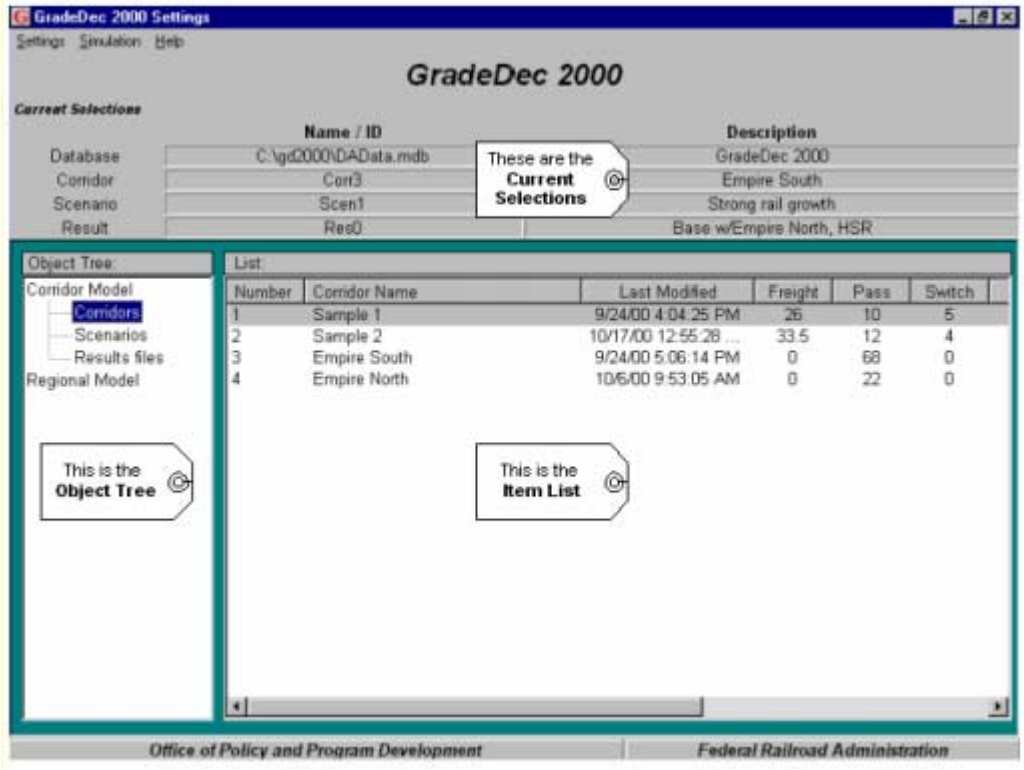

Figure 4 Main Form

Description

This form is the full-screen portal to *GradeDec 2000*. The form is divided into three main sections: 1) **Current Selections** (top of screen), 2) the **Object Tree** (lower left), and, 3) the **Item List** (lower right). In addition, at the top of the screen is a menu that provides access to the "Settings" submenu, "Simulation" and on-screen "Help" options.

How you invoke this form

The Main form is the first form that appears when *GradeDec 2000* is started by double clicking on the GradeDec 2000 icon from the Windows Start menu.

Purpose and Function

From the Main form screen you can: 1) navigate among the corridors, scenarios and results files; 2) launch forms to modify corridor, scenario and results files definitions; 3) launch other forms and functions including run simulation and view help files.

Current Selections

The **Current Selections** are the selected settings that will be used, if left unchanged, in the next simulation. Four components make up the **Current Selections**. These

are: database, corridor or region, scenario and results file. The **Current Selections** show a “Name/ID” and description for each setting. The database name should always show a file name “DAdata.mdb” along with the path where the required files for an analysis are stored.

There are two sets of defaults in *GradeDec 2000*: One for the corridor model and one for the regional model. On start up, *GradeDec 2000* shows the defaults for the corridor model as the **Current Selections** (the defaults are discussed below).

The Object Tree

On start up, the **Object Tree** shows Corridors as the selected node and the **Item List** shows the corridors from the corridor database in the default path folder. When clicking on the regional model node of the **Object Tree**, **Current Selections** changes to the current values for the regional model. Clicking on the corridor model node returns the settings to those of the corridor model.

Clicking on a node of the **Object Tree** selects the object and displays the items associated with the object in the **Item List** (i.e., clicking on the "Scenarios" node under corridor model will highlight the node and will display the scenarios of the corridor model in the **Item List**).

Double-clicking on the nodes of the **Object Tree** will invoke the respective modify definition form for corridors, regions, scenarios and results files.

The Item List

The **Item List** displays a list of the items that are associated with the object that is selected in the **Object Tree**. For each item, the **Item List** shows all of the definitional information associated with the item. Using the **Item List** you can change the settings for the corridor or region, scenario and results file

Clicking on the item number selects that item and makes it the current selection. For instance, if the list displays “Scenarios” and you click on number 2 then that scenario becomes the selected scenario. You can browse among items on the **Item List** using the up and down keys. Moving with the arrow keys also changes the item selection.

Double-clicking on an item in the **Item List** will launch the form that enables the viewing or editing of the selected item Specifically:

- Double-clicking on a corridor in the **Item List** will launch the Corridor Crossing Data Entry form for viewing and editing crossing data and calculating base year accident rates within the corridor.
- Double-clicking on a scenario in the **Item List** will launch the Scenario Data Input Screen for viewing and editing scenario data.
- Double-clicking on a results file in the **Item List** will launch the Result Screen for viewing results tables and charts. If you select a results file in the **Item List** and press "r", the system will re-set the settings to those that generated the results and will launch the Simulation form.

- Double-clicking on a region item in the **Item List** will launch the Regional Crossing Data Entry form for viewing and editing crossing data and calculating base year accident rates within the region.

The Menu

The following are the menu items and their functions:

Settings > Database and data > Select the database

Using the "Select the database" option from the menu, you can change the active database and file folder. Choose the "Select the database" option and use the dialogue box to specify the new folder and database, then click "OK".

Recommended Practice: If you want to preserve an analysis, create a new folder and copy all of the files from your working folder (except the gd2.exe program executable) to the new folder. Then choose the "Select the database" menu option and select the DAdata.mdb database in the new folder. All subsequent work will be recorded in the new folder (until you exit and re-enter the program, or, restore the defaults). Save the new settings as defaults if you want to continue working in the new folder.

Settings > Database and data > View or edit data tables

Choosing this option launches the Data Tables form that contains parameters, coefficients and default improvement cost values used by the *GradeDec 2000* model. See Data Tables Form (2) below.

Settings > Defaults > Save *and* Settings > Defaults > Restore

The default settings are those that appear when *GradeDec 2000* is opened. The settings include: database, corridor, scenario and results file. You can restore the default settings by choosing "Defaults-Restore" from the "Settings" menu. You can also make your Current Selections the default settings by choosing the "Defaults-Save" option from the "Settings" menu.

Settings > Compact database

The "Compact Database" option in the "Settings" menu will remove empty space from your database file. If you conduct many analyses with numerous scenarios you may improve the speed of some of *GradeDec 2000*'s functions by occasionally running this option.

Settings > Delete – selected corridor, region, scenario, results file

The "Delete" options in the menu will delete the corridor, region, scenario or results file that is specified in the **Current Selection**. Select the corridor, region, scenario or results file you wish to delete before choosing the "Delete" option.

"Delete Corridor or Region" will delete the corridor or region (depending on whether corridor model or regional model is current) definition and all associated crossing data will be deleted from the GCX.mdb database. "Delete Scenario" will delete the scenario definition and all data associated with the scenario in the Dadata.mdb

database. “Delete Results File” will delete the selected results file and its definition in the DAdata.mdb database.

Note: You cannot delete a corridor, region, scenario or results file if it is designated as the default. In order to delete a default setting, first make it non-default by saving new settings as defaults.

Simulation and Help

The “Simulation” option in the Main form menu launches the Simulation form.

Expert Option: The user can select Latin Hypercube, the default, as the simulation method, or, alternately, the user can select the regular Monte Carlo method for simulation. Latin Hypercube is a stratified sampling method and will usually converge to the true result distribution with fewer trials than the Monte Carlo method. If you wish to know more on this subject, a good technical reference is "Latin Hypercube sampling (A Program Users Guide)", by R.L. Iman J.M. Davenport and D.K. Zeigler, Technical Report SAND79-1473, Sandia Laboratories, Albuquerque (1980)

Batch Simulations: This option under the Simulation option in the main menu lets the user define a number of simulations and run them in batch mode (i.e., one after the other without manual intervention).

The “Help” option provides access to the *GradeDec 2000* help file system.

Data Elements

No data are entered in the Main form.

Data Tables Form (2)

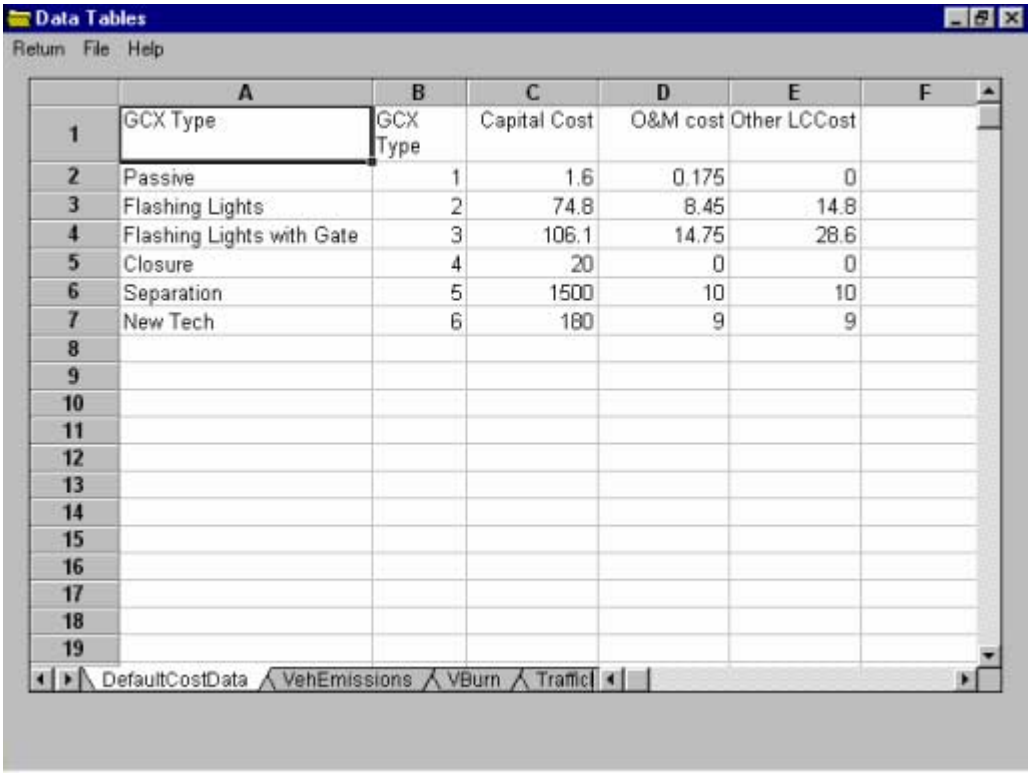

Figure 5 Data Tables Form

Description

The Data Tables form contains a multi-worksheet spreadsheet. Each worksheet contains parameters used in the *GradeDec 2000* model for the following areas: grade crossing default cost data, vehicle emission coefficients by vehicle type and emission type, fuel and oil burn coefficients, daily traffic time-of-day distributions, and high-speed rail model coefficients. See the *GradeDec 2000* Model Reference for additional explanations.

These values can be modified and then saved using the “File save” option in the Data Tables form menu. The Data Tables forms uses values from an MS Excel spreadsheet called "datatab.xls" located in the data files folder.

Note: If you don't use the "Save" or "Save as" menu options, any changes you make will not be saved.

Recommended Practice: If you want to change values in the data tables, use the “Save as” option to save the data tables under a new name. Make your changes and then save the data tables with the “Save” option. The “Save” option saves the data with the name “datatab.xls” and the file with this name is always used by the program. The file you saved under the new name is preserved as a backup.

Note: ***Do not 1) move cells; 2) add or delete rows or columns; or 3) add, delete or re-order worksheets.*** Changing the row, column or sheet position of any of the values in the spreadsheets will cause the model to generate erroneous outcomes.

If you modify "datatab.xls" using Microsoft Excel you must save the spreadsheet in Excel 5.0 format.

How you invoke this form

This form is invoked from the Main Form menu by choosing **Settings>Database and data>View or edit data tables**.

Purpose and Function

The Data Tables form enables the user to access model parameters for reference and for editing, if necessary. In most applications it is unlikely that a user will wish to modify the emission and fuel burn coefficients. The user may wish to modify the time-of-day traffic distributions if localized information is available that better characterizes these distributions. There may well be local guidance on grade crossing operating and maintenance costs and these should be modified as needed.

Data Elements

The data elements for this form are discussed in the *GradeDec 2000* Model Reference. The analyst should verify that the default values in these tables are suitable for local conditions and modify as needed.

Simulation Form (3)

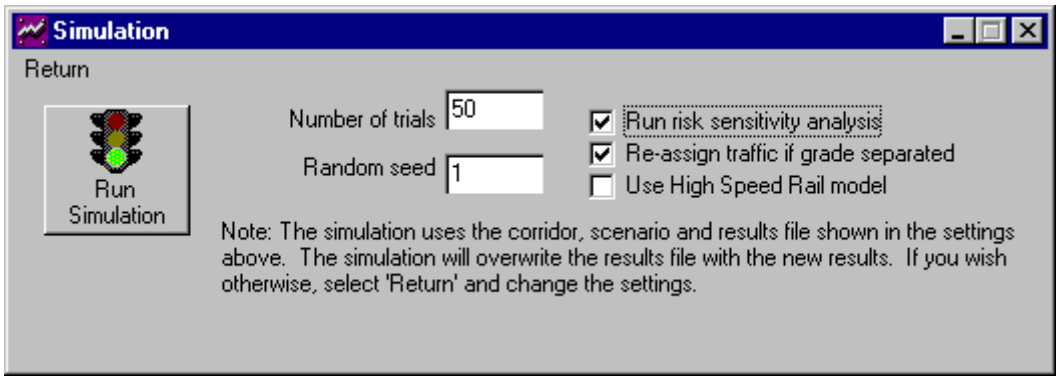

Figure 6 Simulation Form

Description

Use the Simulation form to set the simulation parameters and begin a simulation. The form appears overlaid on the **Current Selections** thus allowing you to view these when setting the simulation parameters. You should invoke this form only when you

are ready to conduct a simulation, that is, after having made all required modifications to data, and after having selected the corridor (or region), scenario and results file. Note that the bottom two checkboxes appear only with the corridor model and not with the regional model.

How you invoke this form

The Simulation form is invoked from the Main form menu. Alternately, you can invoke this form by selecting a results file in the **Item List** and pressing "r".

Purpose and Function

The Simulation form is used to run a simulation. Use the form to set the simulation parameters and initiate the simulation. The simulation parameters are discussed below.

About Simulation

GradeDec 2000 uses simulation, or risk analysis, to generate result forecasts. By specifying probability distributions for scenario inputs, the user quantifies their variability and uncertainty. The impact of this uncertainty on the outcomes, as reflected in the *GradeDec 2000* analytic model, is quantified using simulation.

With simulation, rather than solving the model once using "best guess" values for inputs, *GradeDec 2000* solves the model for many independent trials. In each trial, a random sample is taken from the distribution of each scenario input. Each trial produces an outcome (e.g., a set of values for the result variables) that is as likely to be achieved as any other. By applying statistical analysis to a set of outcomes, *GradeDec 2000* derives descriptive statistics for each result variable. Thus, for instance, *GradeDec 2000* will tell us not only that "the answer is 50", but also that "with 90% probability the answer lies between 30 and 75". As opposed to point estimates or sensitivity analysis (where one variable is arbitrarily varied), risk analysis supports better decisions by explicitly reporting the probability distributions of the results.

Also see the section "Why *GradeDec 2000*" in the Introduction.

Trials Box

Enter the number of trials for the simulation. The number of trials is the number of times that the program will sample from the scenario input distributions, solve the model and generate results. More trials will yield more stable results and will take more time to run. While a number of factors will determine the minimum number of trials needed to achieve stable results, 500 trials will almost always be adequate. You must use at least 3 trials to run a simulation.

Recommended Practice: To save time, when testing your data and assumptions, use a small number of trials (50 or less). After you are satisfied that you will make no more changes to the data, then run a simulation with a large number of trials to arrive at your final result.

Random Seed Box

The random seed determines the sequence of pseudo-random numbers that are generated by the simulation engine. Any positive integer value will generate a unique sequence of pseudo-random numbers for the simulation. Two simulations with identical data, number of trials and random seed will generate identical results.

Changing the random seed is an expert option. You may want to change the random seed to test the effects of the randomness of the sampling on the result distributions.

Risk Sensitivity Analysis Check Box

The risk sensitivity analysis runs the *GradeDec 2000* model with all the input variables except one set to their mean values. The exception input variable is set to its 10 percent lower value and the model is solved. This input variable is then set to its 10 percent upper value and the model is solved again. This process is repeated for all input variables. The results of the sensitivity analysis are displayed in the tornado chart, which is invoked from the Results form.

By leaving this box unchecked your results file will not contain values for the tornado chart. When there are numerous grade crossings in a region or corridor, the risk sensitivity analysis can greatly increase the time required to run a simulation. You may prefer to sacrifice the risk sensitivity analysis in favor of shorter run times by not checking the box.

"Re-Assign Traffic, If Grade Separated" Check Box

This check box appears on the Simulation form only when using the corridor model. In the *GradeDec 2000* corridor model, there is an algorithm that re-assigns highway traffic from the adjacent grade crossings to an improved crossing with grade separation. This box is checked by default and by removing the check you choose to run your simulation without the re-assignment of traffic.

"Use HSR Model"

This check box appears on the Simulation form only when using the corridor model. If this box is checked, then the simulation uses the HSR model algorithms to calculate the safety improvements (i.e., risk reduction) at the crossings. By default, when this box is unchecked, the model uses the algorithms specified by the US DOT Accident Prediction and Severity Model. The *GradeDec 2000* Model Reference and Documentation presents a fuller description of the models and their modes of usage.

"End of Simulation"

The End of Simulation notification shows when the simulation ends. The notification allows two options: View results (which invokes the Results form), or, Return to Current Selections.

Data Elements

The number of trials and random seed values are stored in the results file definition and appear in the List View of the Main form.

Modify Corridor Definition Form (4.1)

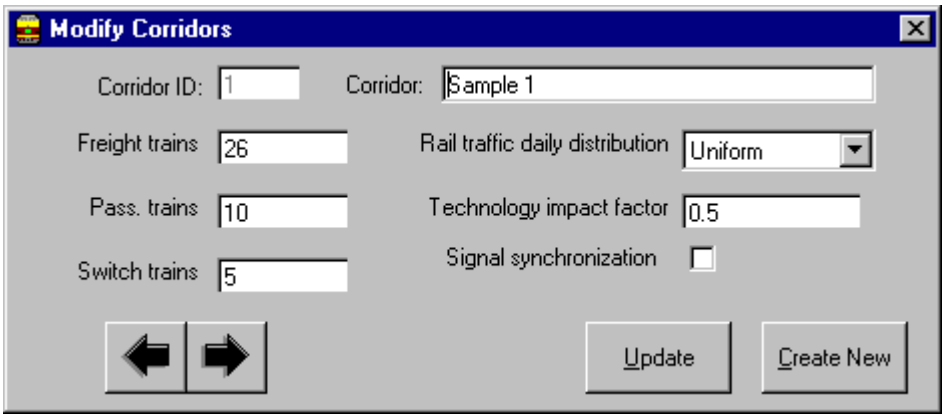

Figure 7 Modify Corridor Definition Form

Description

This form is specific to the corridor model and is used to modify the definitional data for corridors.

How you invoke this form

You invoke this form by double-clicking on the corridors node of the **Object Tree** in the Main form.

Purpose and Function

Use this form to change the description and the global parameters for a corridor (i.e., parameters that apply to all the crossings in a corridor). Use this form to invoke the Create New Corridor form.

Use the data control at the bottom of the form to browse among the existing corridor definitions. Find the corridor definition whose information you wish to modify.

After changing information, you must press the "Update" button on the form before moving to a different corridor definition or exiting the form (otherwise, your changes will not be saved). Exit the form by clicking on the "X" in the upper right hand corner.

Data Elements

The modifiable information for a corridor includes: corridor description, average number of trains per day, number of switch trains, rail traffic daily distribution in the

corridor, technology impact factor and presence of signal synchronization (see the *GradeDec 2000* Model Reference for a detailed explanation of all the information and its use in the model). Numeric values must be non-negative and can be non-integer (e.g., 10.7). The technology impact factor must be a decimal number between 0 and 1 inclusive.

A corridor definition record is stored for each corridor in the Corridors table in the GCX.mdb database in the active file folder.

Create New Corridor Form (4.1.1)

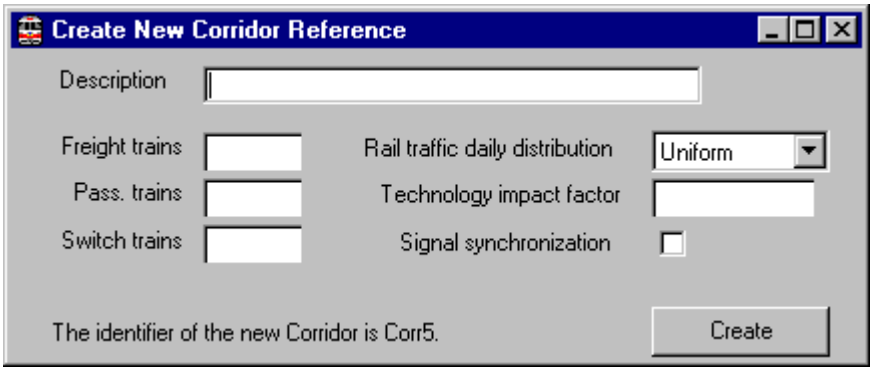

Figure 8 Create New Corridor Form

Description

In the Create New Corridor form you define a new corridor. A newly created corridor can then be populated with crossing data. In the definition of a corridor you specify all of the information cited in the Modify Corridor form (and which appears in this form shown above). Press "Create" after you have specified your information.

How you invoke this form

You invoke this form by pressing the Create New Corridor button on the Modify Corridor form.

Purpose and Function

Use this form to create a new corridor definition and set its global parameters (i.e., those that apply to all crossings in the corridor) .

Data Elements

The information for a corridor includes: corridor name, average number of trains per day, number of switch trains, rail traffic daily distribution in the corridor, technology impact factor and presence of signal synchronization (see the *GradeDec 2000* Model Reference for a detailed explanation of all the information and its use in the model). Numeric values must be non-negative and can be non-integer (e.g., 10.7). The technology impact factor must be a decimal number between 0 and 1 inclusive.

A corridor definition record is stored for each corridor in the Corridors tables in the GCX.mdb database.

Modify Scenario Definition Form (4.2)

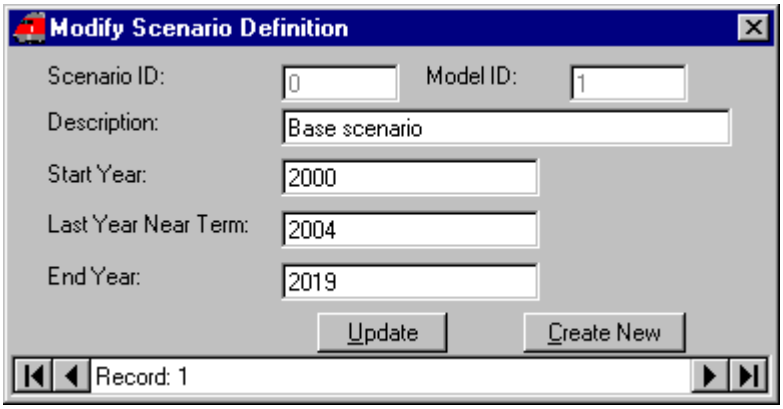

Figure 9 Modify Scenario Definition Form

Description

This form is used to modify the scenario definition. You can change the scenario description and the analysis year parameters for a scenario (see the Data Elements section below).

How you invoke this form

You invoke this form by double-clicking on the scenarios node (under corridor or regional model) of the **Object Tree** in the Main form.

Purpose and Function

Use this form to change the description and the three year values for a scenario. Use this form to invoke the Create New Scenario form.

Use the data control at the bottom of the screen to browse among the existing scenarios. Find the scenario definition whose information you wish to modify.

After changing information, you must press the “Update” button on the form before moving to a different scenario definition or exiting the form (otherwise, your changes will not be saved). Exit the form by clicking on the “X” in the upper right hand corner.

Data Elements

The modifiable data for a scenario definition include: a description, a start year, the last year of the near term and the end year. The "last year of the near term" is the last year in which near-term growth rates are applied. The scenario identification number is assigned by *GradeDec 2000* and is not subject to modification by the user. The

model identification number specifies whether the scenario is a scenario for the corridor model (Model ID = 1) or for the regional model (Model ID = 2).

The scenario definition data are saved in the ScenDefs table in the DAdata.mdb database.

Create New Scenario Form (4.2.1)

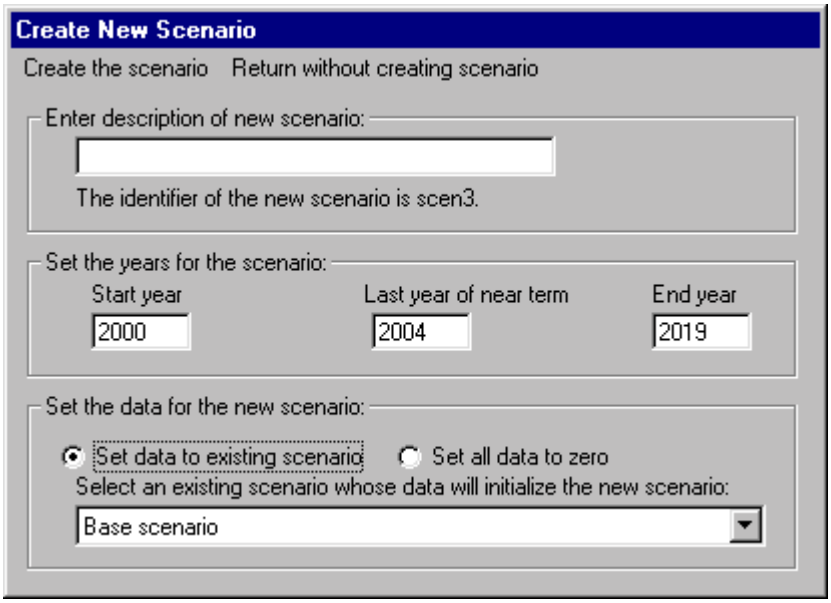

Figure 10 Create New Scenario Form

Description

In the Create New Scenario form you specify the description, the start year of the scenario, the last year of the near term and the scenario's end year. You must also specify whether to set all data values to zero, or, copy data values from an existing scenario. If you choose the “Copy Data” option, then you must specify an existing scenario using the pull-down menu in the form. Press “Create” after completing the form.

How you invoke this form

You invoke this form by pressing the Create New Scenario button on the Modify Scenario form.

Purpose and Function

Use this form to create a new scenario. The near term and long term are for rail and highway traffic growth rates. For instance, if the first, last year near term and last year are 2000, 2004 and 2010 and near term highway traffic growth is 4% and long term growth is 2.5%, then traffic is calculated like in the following table

	NEAR TERM					LONG TERM					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Highway traffic (AADT)	1000	1040	1082	1125	1170	1199	1229	1260	1291	1324	1357
Growth rate (%)		4.0	4.0	4.0	4.0	2.5	2.5	2.5	2.5	2.5	2.5

Data Elements

The modifiable data for a scenario definition include: a description, a start year, the last year of the near term and the end year. The "last year of the near term" is the last year in which near-term growth rates are applied. The scenario identification number is assigned by *GradeDec 2000* and is not subject to modification by the user. The model identification number specifies whether the scenario is a scenario for the corridor model (Model ID = 1) or for the regional model (Model ID = 2).

The scenario definition data are saved in the ScenDefs table in the DAdata.mdb database.

Modify Results File Definition Form (4.3)

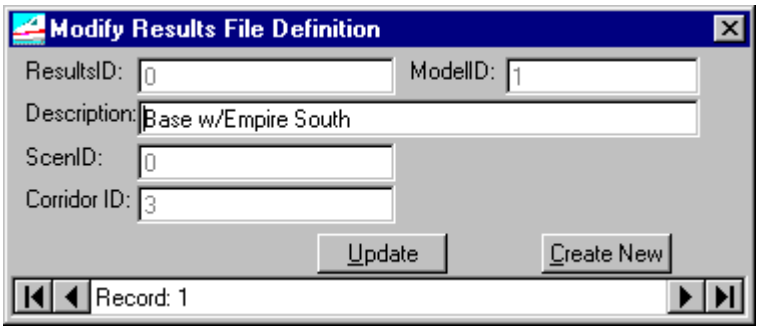

Figure 11 Modify Results File Definition Form

Description

This form is used to modify the results file definition. The only modifiable information is the file description.

How you invoke this form

You invoke this form by double-clicking on the results files node (under corridor or regional model) of the **Object Tree** in the Main form.

Purpose and Function

Use this form to change the description of the results file. From this form you can invoke the Create New Results File form.

Use the data control at the bottom of the screen to browse among the existing scenarios. Find the results file definition whose information you wish to modify.

After changing information, you must press the “Update” button on the form before moving to a different results file definition or exiting the form (otherwise, your changes will not be saved). Exit the form by clicking on the “X” in the upper right hand corner.

Data Elements

The modifiable data for a results file definition are its description only. The results file identification number is assigned by *GradeDec 2000* and is not subject to modification by the user. When a simulation is run, *GradeDec 2000* stores the number of trials, random seed and time-date of the simulation in the same record as the results file definition.

The results file definition data are saved in the Results table in the DAdata.mdb database.

Create New Results File Definition Form (4.3.1)

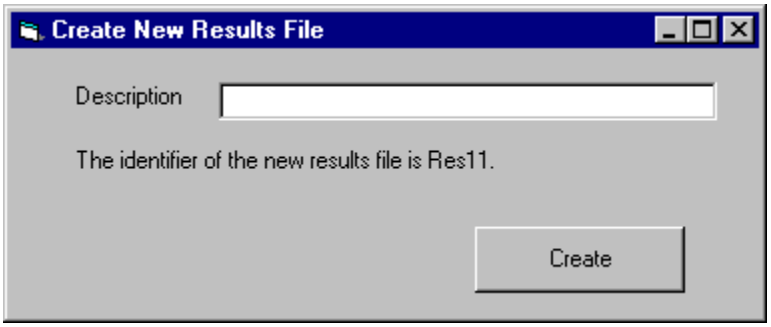

Figure 12 Create New Results File Definition Form

Description

In the Create New Results File form you specify the description of the new results file.

How you invoke this form

You invoke this form by pressing the Create New Results File button on the Modify Scenario form.

Purpose and Function

Use this form to create a new results file definition. The new results file is created only when the simulation is run. Each time you run a simulation using the same results file as the current selection, the previous results file is deleted and a new results file is created.

Data Elements

The modifiable data for a results file definition are its description. When creating a new results file with this form, *GradeDec 2000* assigns a results file number and the corridor or regional model ID number (1 or 2, respectively). When you run a simulation, the number of trials, random seed and time-date data are written to the results file definition record. The results file definitions are stored in the Results table of the DAdata.mdb database.

The results files themselves are separate files in the active file folder and have names Resx.mdb where x is the identifying number that is assigned to the results definition by *GradeDec 2000*.

Modify Region Definition Form (5.1)

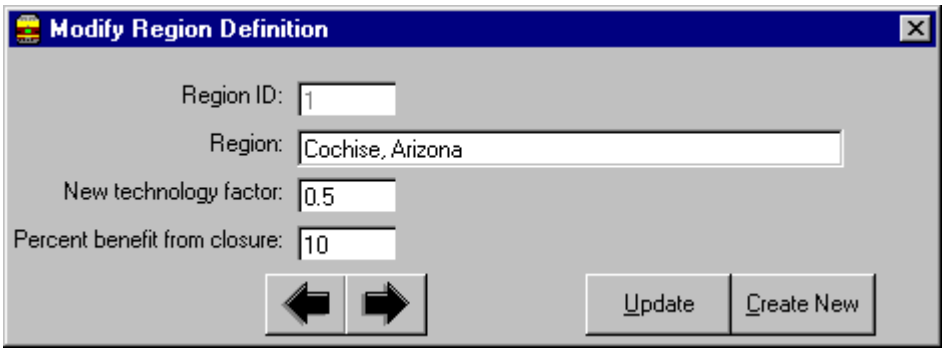

Figure 13 Modify Region Definition Form

Description

This form is specific to the regional model and is used to modify the definitional data for regions.

How you invoke this form

You invoke this form by double-clicking on the regions node of the **Object Tree** in the Main form.

Purpose and Function

Use this form to change the description and the technology impact parameter for a region. Use this form to invoke the Create New Region form.

Use the data control at the bottom of the form to browse among the existing region definitions. Find the region definition whose information you wish to modify.

After changing information, you must press the "Update" button on the form before moving to a different region definition or exiting the form (otherwise, your changes will not be saved). Exit the form by clicking on the "X" in the upper right hand corner.

Data Elements

The modifiable information for a region includes: region description and technology impact factor (see the *GradeDec 2000* Model Reference for a detailed explanation of all the information and its use in the model). The technology impact factor must be a decimal number between 0 and 1 inclusive.

A region definition record is stored for each region in the Regions table in the GCX.mdb database in the active file folder.

Create New Region Form (5.1.1)

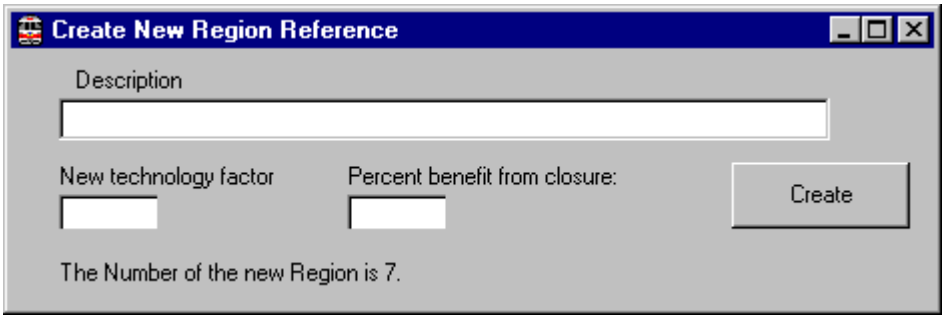

Figure 14 Create New Region Definition Form

Description

In the Create New Region form you define a new Region. A newly created region can then be populated with crossing data. In the definition of a region you specify the information cited in the Modify Region form (and which appears in this form shown above). Press "Create" after you have specified your information.

How you invoke this form

You invoke this form by pressing the Create New Region button on the Modify Region form.

Purpose and Function

Use this form to create a new region definition.

Data Elements

The modifiable information for a region includes: region description and technology impact factor (see the *GradeDec 2000* Model Reference for a detailed explanation of all the information and its use in the model). The technology impact factor must be a decimal number between 0 and 1 inclusive.

A region definition record is stored for each region in the Regions table in the GCX.mdb database in the active file folder.

Corridor Crossing Data Form (6)

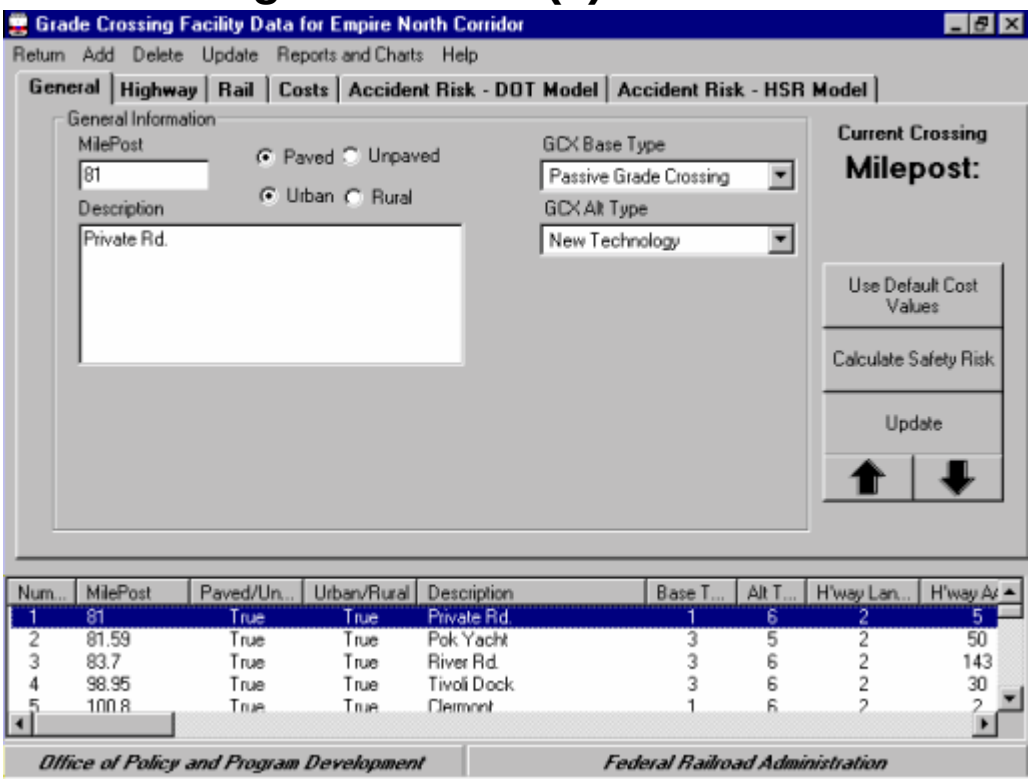

Figure 15 Corridor Crossing Data Form

Description

Use this form in grade crossing corridor analysis to:

- View crossing data
- Add, modify and delete crossing data.

How you invoke this form

You invoke this form by double-clicking on a corridor in the **Item List** from the **Current Selections** on the **Main** form.

Purpose and Function

The **Corridor Crossing Data** form is divided into two main sections: 1) the **Crossing Data Entry Form** (top of the screen), and, 2) the **Item List** (bottom of the

screen). You use the **Item List** to select a crossing to view or edit. Data entry and modification to crossing data are entered on the data form. You navigate among topics on the data entry form for the selected crossing by clicking on a tab at the top of the form.

The buttons on the form facilitate data entry for accident data and cost data. After modifying data use the “Update” button to save your changes. Other features can be accessed from the menu at the top of the very top of the form.

Crossing Data Entry Form

General Information

This block of the data entry form contains general information about the crossing, locational factors and its physical characteristics. The base and alternate type for the crossing are the "before" and "after" improvement crossing types, respectively. Using the mouse, click on the field where you wish to enter data. For “GCX Base Type” and "GCX Alternate Type", use the pull-down menus.

Note: When analyzing a corridor, you must specify in the data the milepost location of each grade crossing. The difference in successive milepost numbers is equal to the distance in miles between the crossings.

Highway

The highway data block includes data entry boxes for the number of lanes, AADT and percentages of trucks (and of trucks, percent truck-trailers) and buses. The data block also includes pull-down menus where the user specifies the time-of-day traffic distribution for auto, truck and bus traffic.

Rail

In the rail data block the user specifies the number of tracks and train speeds. The user specifies the maximum timetable speed at the crossing and the average speeds traveled by trains of different types at the crossing.

Costs

The cost data block contains the cost data for the crossing in the base and alternate cases. You can enter the data manually for each crossing, or you can use the default costs that are stored in the Data Tables (see Data Tables form) by pressing "Use Default Values".

Accident Risks – DOT Model

This block contains one data entry box for accidents at the crossing in the previous five-year period. The other information that is presented on this screen is the calculated accident rates and predicted number of accidents at the crossing based upon the accident history and crossing data that was entered in the general, highway and rail data blocks. The rates and predicted accidents are updated when the user presses the "Calculate Safety Risk" button. The rates and predicted accidents are calculated using the US DOT Accident Prediction and Severity Formulas and Resource Allocation Method (see the *GradeDec 2000* Model Reference and Documentation).

This block displays accident risks as both a rate ("predicted accidents per 100 million exposures") and "predicted accidents per year". Exposures per day are the number of trains per day times the average annual daily traffic per day (adjusted for the correlation of time-of-day rail with highway traffic by traffic segment (auto, truck and bus) – see the *GradeDec 2000* Model Reference and Documentation).

Accident Risks – HSR Model

This portion of the data entry form shows the calculated accident risks using the High Speed Rail Model. The rates and predicted accidents on this block of the form are updated when the user presses the "Calculate Safety Risk" button.

Updating Data

After entering or modifying the data for a grade crossing, press the “Update” button to save the new data in the corridor database. If you move to another crossing in the item list or exit the Corridor Crossing Data form without pressing the “Update” button, you will lose any information that you entered since you last pressed “Update”.

Note: Pressing the "Update" button does not recalculate the predicted accidents and rates based upon new or changed crossing or corridor data. In order to recalculate the rates and save them in the crossing database you must: 1) Press the "Calculate Rates" button and then 2) Press the "Update" button. There is a menu option that will calculate and update the predicted accidents and rates for all records.

Navigation Arrows

Clicking on these arrows moves the selection to the next crossing in the **Item List.** When the selected item changes, the data of the selected item are shown in the data entry form.

Item List

Click on a row in the **Item List** selects a crossing. This will display the crossing's information on the Corridor/Crossing Data Form. Using the shift button and the control button you can select multiple crossings (only the first crossing selected is shown in the Crossing Data Entry form). Multiple selections can be used with the "Delete" function in the form's menu.

Corridor Crossing Data Form Menu

Return

Choosing the “Return” option will send you back to the Settings Screen.

Add

Choosing the “Add” option in the menu will give a blank form for entering data for a new crossing. If you enter a milepost that already exists, the new data that you enter will overwrite the existing data for the crossing when you press “Update”. Otherwise, pressing “Update” will record the new crossing in the corridor database.

Delete

Choosing the “Delete” option will delete the data for the selected crossing(s).

Update

The "Update" option enables the user to globally update for all crossings in the corridor: 1) the costs to the default cost values and, 2) the calculated predicted accidents and rates.

Reports and Charts

"Print Corridor – DOT Model Report"

Prints a report of the data for the corridor including all crossings and the associated predicted accidents and rates using the DOT model.

"Print Corridor – HSR Model Report"

Prints a report of the data for the corridor including all crossings and the associated predicted accidents and rates using the High Speed Rail model.

"Crossing Risk Charts (DOT Model)"

Launches risk ranking charts with DOT model (see form 6.1 below).

"Crossing Risk Charts (HSR Model)"

Launches risk ranking charts with HSR model (see form 6.1 below).

Help

Launches the User's Manual on-line help system.

Data Elements

Use this form to view, enter, modify or delete crossing data for a corridor analysis. Crossing data are stored in the GCX table of the GCX.mdb database in the file folder. Each crossing record includes fields for raw data and fields for the calculated predicted accident rates by severity for the base and alternate cases.

Risk Ranking Charts for DOT and HSR Models (6.1)

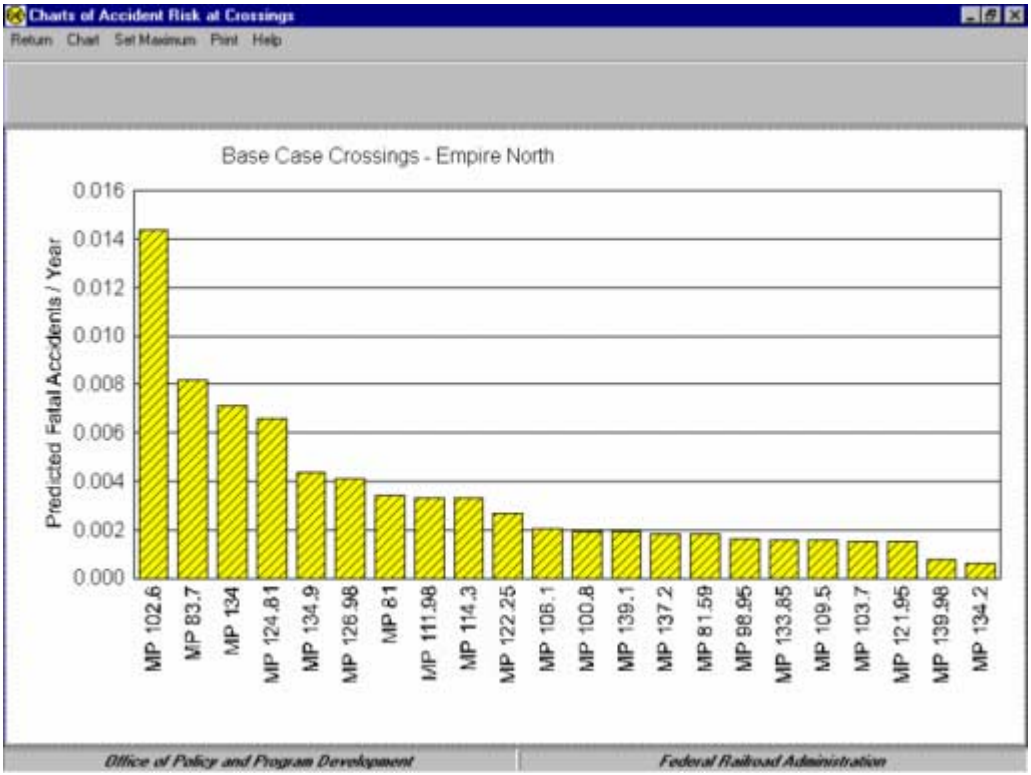

Figure 16 Corridor Risk Ranking Chart

Description

This form displays a series of charts that rank the crossings in a corridor based upon predicted fatal accidents (for the DOT model) or predicted fatalities (for the HSR model).

How you invoke this form

You invoke this from the menu option Reports and Charts>Crossing Risk Charts (DOT Model) or Reports and Charts>Crossing Risk Charts (HSR Model).

Purpose and Function

This form displays a ranking of crossing by risk for both the base and the alternate cases. The form includes several charts, namely:

- Risk ranking - bar chart
- Risk ranking - horizontal bar chart
- Cumulative risk by ranked crossings

- First/Next chart – stacked bars showing risk at fist n crossings and next m crossings.

The form displays a maximum number of 30 crossings. The user can manually set the maximum number of crossings to less than 30.

Data Elements

This form displays data that was entered, calculated and stored with the Crossing Data Form.

Regional Crossing Data Form (7)

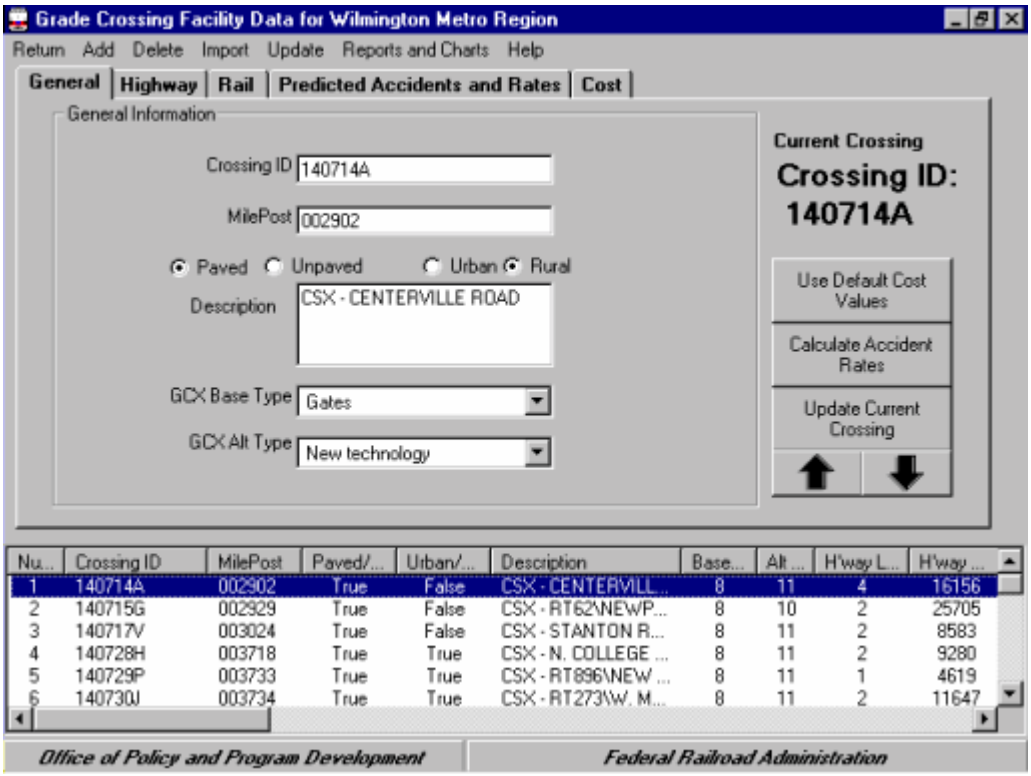

Figure 17 Regional Crossing Data Form

Description

Use this form in grade crossing regional analysis to:

- View crossing data
- Add, modify and delete crossing data
- Invoke the Import Data form.

How you invoke this form

You invoke this form by double-clicking on a region in the **Item List** from the **Current Selections** on the **Main** form.

Purpose and Function

The **Regional Crossing Data** form is divided into two main sections: 1) the **Crossing Data Entry Form** (top of the screen), and, 2) the **Item List** (bottom of the screen). You use the **Item List** to select a crossing to view or edit. Data entry and modification to crossing data are entered on the data form. The buttons on the form facilitate data entry for accident data and cost data. After modifying data use the "Update" button to save your changes. Other features can be accessed with the menu at the top of the screen.

Crossing Data Entry Form

If you plan to import data from the National Grade Crossing Inventory Database, you can skip to the next form and review the details below at your convenience.

General Information

This block of the data entry form contains general information about the crossing, locational factors and its physical characteristics. The base and alternate type for the crossing are the "before" and "after" improvement crossing types, respectively. Using the mouse click on the field where you wish to enter data. For "Crossing Type", use the pull-down menus.

Highway

The highway data block includes data entry boxes for the number of lanes, AADT and percentages of trucks and buses. The data block also includes pull-down menus where the user specifies the time-of-day traffic distribution for auto, truck and bus traffic.

Rail

In the rail data block the user specifies the number of tracks and train speeds for through and switch trains. The user specifies the maximum timetable speed at the crossing and the time-of-day distribution of train activity at the crossing using the pull-down menu.

Costs

The cost data block contains the cost data for the crossing in the base and alternate cases. You can enter the data manually for each crossing, or you can use the default costs that are stored in the Data Tables (see Data Tables form) by pressing "Use Default Values".

Accident Data

This block contains data entry boxes for accidents at the crossing in each of the previous five years. The other information that is presented on this screen is the calculated accident rates and predicted number of accidents at the crossing based upon the accident history and crossing data that was entered in the general, highway and rail data blocks. The rates and predicted accidents are updated when the user presses the "Calculate Safety Risk" button. The rates and predicted accidents are calculated using the US DOT Accident Prediction and Severity Formulas and Resource Allocation Method (see the *GradeDec 2000* Model Reference and Documentation).

Updating Data

After entering or modifying the data for a grade crossing, press the “Update” button to save the new data in the regional database. If you move to another crossing in the item list or exit the Regional Crossing Data form without pressing the “Update” button, you will lose any information that you entered since you last pressed “Update”.

Note: Pressing the "Update" button does not recalculate the predicted accidents and rates based upon new or changed crossing or corridor data. In order to recalculate the rates and save them in the crossing database you must: 1) Press the "Calculate Rates" button and then 2) Press the "Update" button. There is a menu option that will calculate and update the predicted accidents and rates for all records.

Navigation Arrows

Clicking on these arrows moves the selection to the next crossing in the **Item List.** When the selected item changes, the data of the selected item are shown in the data entry form.

Item List

Click on a row in the **Item List** selects a crossing. This will display the crossing's information on the Regional Crossing Data Entry Form. Using the shift button and the control button you can select multiple crossings (only the first crossing selected is shown in the Crossing Data Entry form). Multiple selections can be used with the "Delete" function in the form's menu.

Regional Crossing Data Form Menu

Return

Choosing the “Return” option will send you back to the Settings Screen.

Add

Choosing the “Add” option in the menu will give a blank form for entering data for a new crossing. If you enter a crossing ID that already exists, the new data that you enter will overwrite the existing data for the crossing when you press “Update”. Otherwise, pressing “Update” will record the new crossing in the corridor database.

Delete

Choosing the “Delete” option will delete the data for the selected crossing(s).

Update

The "Update" option enables the user to globally update for all crossings in the corridor: 1) the costs to the default cost values and, 2) the calculated predicted accidents and rates.

Reports and Charts

"Print crossing data report"

Prints a report of the data for the corridor including all crossings and the associated predicted accidents and rates.

"Show Risk Charts "

Launches risk ranking charts (see form 7.2 below).

Help

Launches the User's Manual on-line help system.

Import

Invoke the Import Data from the National Crossing Inventory form.

Data Elements

Use this form to view, enter, modify or delete crossing data for a regional analysis. Regional crossing data are stored in the RGCX table of the GCX.mdb database in the file folder. Each crossing record includes fields for raw data and fields for the calculated predicted accident rates by severity for the base and alternate cases.

Import Data from National Inventory Form (7.1)

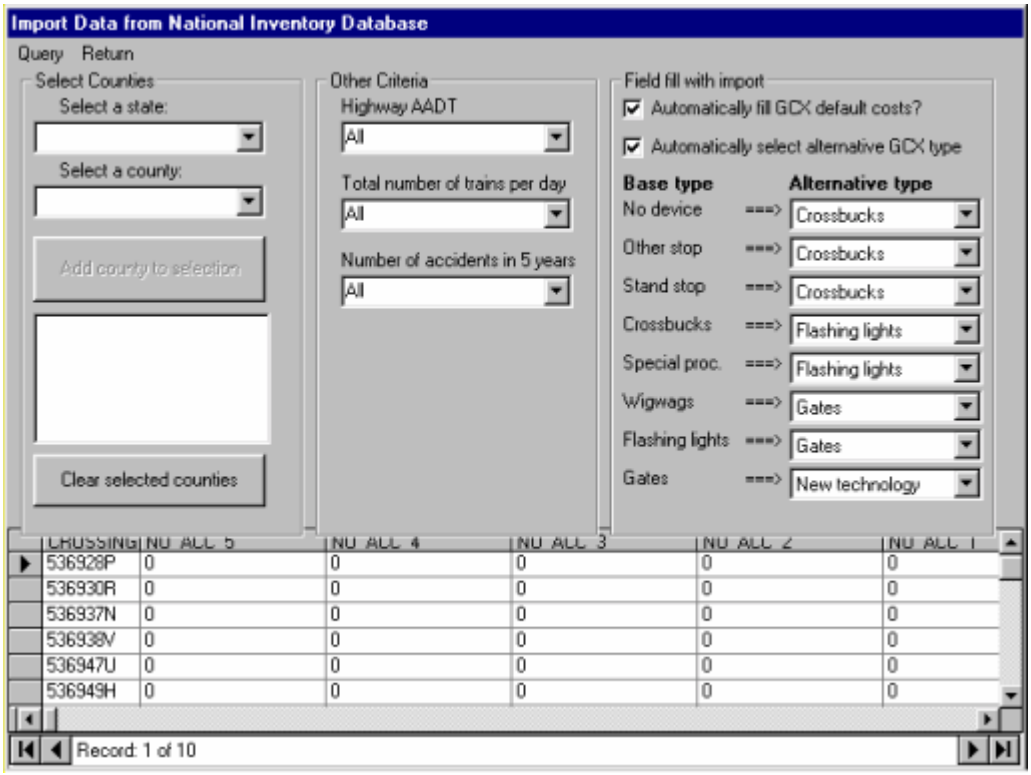

Figure 18 Import Data from National Inventory Form

Description

Use this form to import data from the FRA National Inventory of Grade Crossings Database.

How you invoke this form

You invoke this form by choosing the "Import" option in the menu on the Regional Crossing Data form.

Purpose and Function

The purpose of this form is to enable the analyst to extract data from the national inventory of grade crossings and import that data directly into *GradeDec 2000* for analysis*. The form lets the user build a query based on geography and grade crossing characteristics. The form also enables the specification of automatic

* The data in FRA's National Inventory of Highway-Rail Grade Crossings are submitted by state DOTs and should be reviewed for accuracy.

mapping to *GradeDec 2000* fields. The following sections describe the different parts of the form and their functions

"Select Counties"

In this part of the form, the user chooses first the state and then the county from the pull-down menu boxes. When the desired county is shown the user should press the "Add County to Selection" button. A number of counties from different states can be included in a selection. To choose a different selection, press the "Clear Selected Counties" button.

"Other Criteria"

The "Other Criteria" section allows the user to restrict the crossings to import to those that meet specific criteria. The criteria include: average annual daily traffic, number of trains per day and number of accidents in the previous 5 years.

Note: While *GradeDec 2000* allows you to import records that have no train or highway traffic, be aware that the absence of either at a grade crossing will cause a computational error in the model (e.g., divide by zero). To avoid this, you should either exclude crossings with no traffic, or enter data manually for these crossings (assuming that this reflects actual conditions at the crossings).

"Field Fill with Import"

Use this section to determine the automated filling of *GradeDec 2000* fields when importing data. You can specify to use default cost data, or leave cost data blank for manual data entry. The base grade crossing type is the type specified in the National Inventory of Highway-Rail Grade Crossings database. The alternative grade crossing type can be automatically designated using the pull-down menus, or the user can specify that alternative crossing types will be manually entered.

Menu Options

From the form's menu, with Query>View you can view the SQL query statement that is built from your selections (this is an expert option). Query>Run will query the database and fill the data grid at the bottom of the form with the grade crossings from selected counties that meet all the criteria..

By selecting Return>Return without importing data, you return to the Regional Crossing Data form without importing data.

By selecting Return>Return and import data, you return to the Regional Crossing form while importing the requested data. The instructions that you specified in the Import Data form for automatic field fill are executed and the new data records are appended to the existing records in the selected region.

If upon importing data a record already exists with the same crossing ID as a newly imported crossing, the existing record in the region is overwritten by the imported data.

Data Elements

The Import Data form imports data from the national inventory (the database called PCAPS32.mdb) and creates records for use in *GradeDec 2000*.

Regional Risk Ranking Charts Form (7.2)

Description

This form displays a series of charts that rank the crossings in a region based upon predicted fatal accidents.

How you invoke this form

You invoke this from the menu option Reports and Charts>Crossing Risk Charts.

Purpose and Function

This form displays a ranking of crossing by risk for both the base and the alternate cases. The form includes several charts, namely:

- Risk ranking - bar chart
- Risk ranking - horizontal bar chart
- Cumulative risk by ranked crossings
- First/Next chart – stacked bars showing risk at fist n crossings and next m crossings.

The form displays a maximum number of 30 crossings. The user can manually set the maximum number of crossings to less than 30.

Data Elements

This form displays data that was entered, calculated and stored with the Crossing Data Form.

Scenario Data Input Form (8)

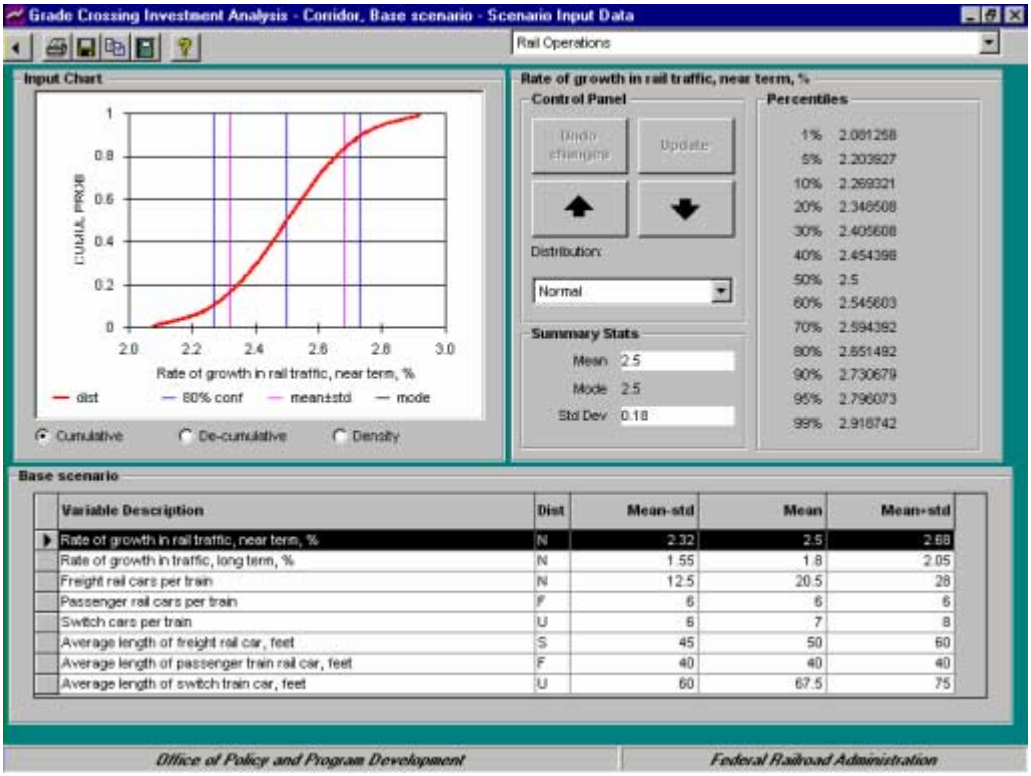

Figure 19 Scenario Data Input Form

Description

The Scenario Input Screen is where you view and edit scenario data for an analysis. Scenario data for a model input variable can be either a fixed value, or several values that describe a probability distribution.

This form possesses a number of features that let you easily visualize data and let you quickly develop probability distributions best reflecting your information and beliefs regarding future developments. These features include:

- Ease of navigation among variables;
- Instant viewing of statistics and charts
- Instant validation and saving of ranges
- Seamless connectivity with spreadsheet software.

How you invoke this form

Invoke this form by double-clicking on the scenario to view or edit in the Main form's **List View.**

Purpose and Function

The Scenario Data Input form is shown above. The variables in *GradeDec 2000* are organized into data sheets according to a functional classification. The data sheets are:

- Rail Operations
- Highway
- Social Costs
- Price Growth Rates

When you invoke the Scenario Input Screen the Rail Operations sheet is loaded and the first variable in that sheet is selected and shown in the chart and tables. You browse among the different sheets using the pull-down menu in the upper right-hand corner of the form.

The remainder of this section describes each component of the Scenario Data Input form and their functions.

Toolbar

The toolbar at the top of the form contains several icon buttons that perform the following functions.

Return to Settings

The left arrow button will exit this form and return you to the Settings Screen.

Print

The print button prints a snapshot of the screen. It invokes your system's printer dialogue box from which you can set your printer settings.

Export (the diskette icon)

The export button sends all of the scenario data to a Microsoft Excel 5.0 spreadsheet. The scenario data will include one row for each variable and the following columns: a) variable name, b) the 50% value, c) the 10% value, d) the 90% value and e) the distribution type. See the discussion on exporting and importing in the section on the Import Data form.

After pressing the icon, the file dialogue box will appear and you will be prompted to either approve the default file name or enter a new name.

Import (the copy icon)

In order to import data follow these steps: 1) open an MS Excel file that was generated using the export feature above in a spreadsheet program, 2) make your changes to the data, 3) select the range of data to import and copy it to the clipboard (Ctrl+C or "Edit-Copy" in most programs), 4) choose the Import (copy icon) button on the Scenario Data input form.

The range you select and copy must include the five columns noted in the "Export" section above. You should not include the column header, that is, never include row 1 (see the Import Data form below).

When you press the copy icon in *GradeDec 2000* a message box will appear asking whether you have copied the data for import to the clipboard. Press "Ok". A *GradeDec 2000* spreadsheet will appear and you have another opportunity to modify the data for import. When you are ready, click the "Import" button to import the data.

Print Report

The report icon will print a report of all the data in the current scenario file.

Data Sheet Pull-Down Menu

Using this pull-down menu in the upper-right-hand corner of the screen, you select the data sheet to view and edit.

Input Chart Area

The chart area contains the chart that correspond to the selected variable. The chart will update automatically when the data are changed or a new variable is selected. For a fixed value, the chart will display the message "No Chart for Fixed Value".

There are three chart types and each shows vertical lines that represent: the mean value, the mean value plus and minus the standard deviation, the mode of the distribution and the values for the 10, 50 and 90 percentiles. The x-axis on all the charts range between the values whose probabilities are 0.5 and 99.5 percent, respectively. The different chart types are selected using the option buttons located beneath the charts.

Cumulative

Chart of the cumulative probability distribution -- see glossary for definition.

De-cumulative

Chart of the de-cumulative probability distribution -- see glossary for definition.

Density

Chart of the probability density function -- see glossary for definition.

Container Frame

The upper-right of the Scenario Input Screen shows the control panel, the summary statistics and the percentiles. The three items are contained within a frame whose caption will always display the description of the selected variable.

Summary statistics

The summary statistics frame displays the mean, mode and standard deviation of the distribution. See the glossary for the definitions.

Percentiles and data input boxes

The percentiles frame displays the percentiles of the distribution.

Control panel

The Control Panel contains the “Update” and “Undo” buttons, the probability distribution type pull-down menu and the "Next" and "Previous" arrow buttons.

Probability distribution pull-down menu

For scenario input variable, you can specify a probability distribution. Regardless of the choice of distribution, three values are stored in the data record for each variable. Depending upon the type of probability distribution, the stored values have different meaning based upon the type of probability distribution.

The types of probability distributions from which you can choose are:

Fixed Value

When you choose fixed value, there is no distribution and the variable assumes a unitary, fixed value for the analysis. For a fixed value, no statistics are shown and only the middle percentile box is enabled for data entry. No chart is shown for a fixed value in the Scenario Data Input form.

For a fixed value, three equal values are stored in the fields of the data record.

Skewed Bell

The skewed bell distribution is derived from three points: the 10% lower value, the 50% value (or, median) and the 10% upper value. The skewed bell distribution fits the three points and is a normal distribution for non-skewed values (i.e., the distance between the 50% and 10% lower values is equal to that between the 50% and the 10% upper values).

This distribution is useful when the exact form of the distribution is not known yet good estimates on the median and boundary values are available.

For the skewed bell distribution, the 10% lower, median and 10% upper values are stored in the database. When this distribution type is selected, the 10, 50 and 90 percentile boxes in the tables are enabled for data entry.

Normal

The normal distribution is defined from two values: the mean and the standard deviation of the distribution. When this distribution type is selected, none of the percentile boxes are enabled for data entry. Data are entered in the statistical summary frame and the mean and standard deviation are available for data entry.

The three stored values for the normal distribution are the mean value, the mean less the standard deviation and the mean plus the standard deviation.

Use this distribution type when you have data indicating the variable is non-skewed and normally distributed.

Uniform

With the uniform distribution every point on an interval is equally likely. When you select this distribution type, the 0 percentile and 100 percentile are enabled for data entry.

With the uniform distribution, the 0 percent (lower value), 50 percent (middle value) and 100 percent (upper value) are stored.

Triangle

For the triangle distribution, you enter data for the maximum value, the minimum value and the most likely value (the mode of the distribution). All values for this distribution lie between the minimum and the maximum and its density function forms a triangle with its peak at the mode. Use this distribution when there are crude data available and when have firm bounds on the maximum and minimum values.

"Update" and "Undo Changes" buttons

After you set the distribution type and enter the data, you save the data for the variable you are viewing by pressing "Update". "Update" tests that the data are valid (i.e., 10-50-90 values are increasing) and then saves the data for the variable in the database. Use the "Undo Changes" button to restore the data from the last update.

"Next variable" button

Pressing the button with the down arrow icon selects the next variable in the data set.

"Previous variable" button

Pressing the button with the up arrow icon selects the previous variable in the data set.

Variable data grid

The variable data grid is displayed at the bottom of the screen. It displays a list of the variables in the data set, the distribution type of the data (S for the standard bell-shaped distribution and U for the uniform distribution), and the three values: Median (middle for uniform distribution, mean for normal), 10% lower (or low value for uniform distribution, mean minus standard deviation for normal) and 10% upper (or high value for uniform distribution, mean plus standard deviation for normal). You can scroll, point and click at a variable in the variable data grid to select it (as an alternative to moving with the arrow buttons in the toolbar).

The pointer at the left side of the variable data grid always points to the currently selected variable. The frame containing the variable data grid will always show the name of the scenario you are viewing.

Navigating the Scenario Data

You navigate among the scenario data with the use of the controls that were described above:

- The data sheet pull-down menu lets you select the subset of data from within the scenario where you want to focus your attention.
- You can use the up and down arrow buttons in the tool bar to move to any variable within the data set. Note that when you select a variable its data values appear in the data boxes in "Percentiles", its description will show in the caption

of the upper right container frame and, the data variable grid pointer will always point to the selected variable.

- You can scroll to the variable you want to view with the variable data grid and point and click on the variable to select it.

Entering Scenario Data

The section describes entering data one variable at a time directly on the Scenario Input Screen. Alternately, you can enter data from a spreadsheet and import it. (see the following section).

After selecting a variable, its values will show in the data boxes in the upper right hand of the screen. The chart, statistics and status of the control panel option buttons will reflect the data currently associated with the variable.

First, decide whether you wish to change the distribution type or make the input a fixed value. After you have chosen the distribution type modify the input data in the data boxes. If you wish to restore the previous values, press “Undo Changes”. After you are satisfied with the new data values press “Accept”. When you press “Accept” the new values have been saved. If you don’t press “Accept” and move to a new variable, or, leave the screen you will lose any changes you have made to the variable data.

Press the “Print” icon on the toolbar to print the screen. This will invoke your printer’s print dialogue box and you can change your print settings and then click on “Ok” to print.

Data Elements

You enter and modify scenario data through this form. Each record includes the full variable name, the model ID number, a scenario number, a value identifying the distribution type and three data values. Scenario data are stored in the Data table of the DAdata.mdb database. A scenario data record can be shared by a number of different scenarios. There is a scenario number field that identifies which scenarios the record is a member of.

Import Scenario Data Form (8.1)

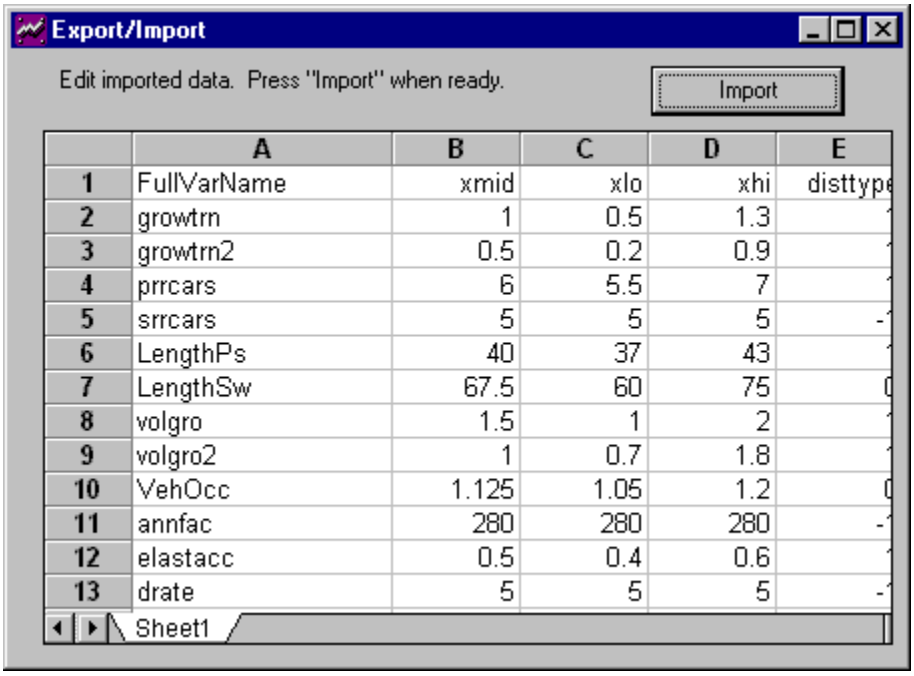

Figure 20 Scenario Data Import Form

Description

The data import form is an intermediate step in the importing of data from a spreadsheet program. After copying data to the clipboard from a spreadsheet, the form appears when you press the import (copy icon) button on the Scenario Data Input form.

How you invoke this form

Invoke this form by pressing the import (copy icon) button on the toolbar of the Scenario Data Input form.

Purpose and Function

Exporting and importing data via a spreadsheet is useful when you are initializing a scenario and wish to modify much of a scenario's data. After importing data you can then review the data one variable at time as a check.

To export data just press the "Export" button in the tool bar at the top of the screen.. A dialogue box will appear that will enable you to specify a file name and path. The file will be saved in Microsoft Excel 5.0 format. After exporting the scenario data, you can go to your spreadsheet program and open the file you saved.

After you have changed the data in the spreadsheet, select the data you wish to import and copy it (Ctrl+C or "Edit-copy" in most spreadsheet programs). Return to the

GradeDec 2000 program, return to the Scenario Input Screen and press “Import” from the tool bar. See the Import and Export descriptions in the tool bar section above.

Data Elements

The import form data elements are identical to those for the Scenario Data Input form.

Results Form (9)

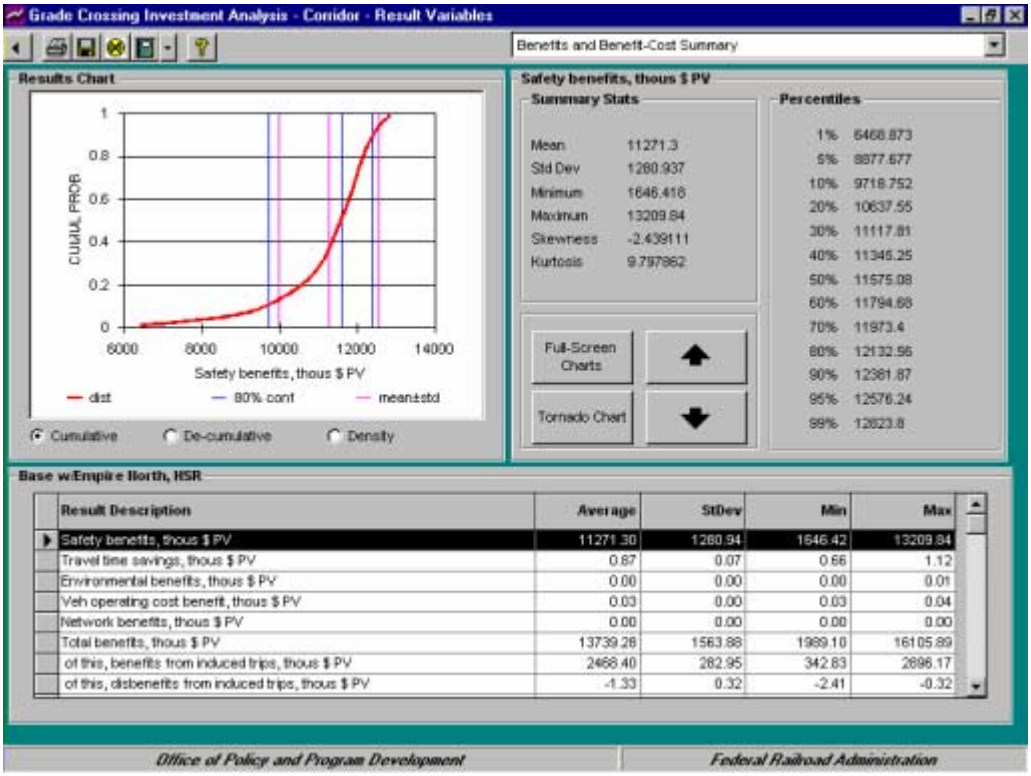

Figure 21 Results Form

Description

The results of a simulation are viewed in the Results form. When the form is first invoked it shows the first results data sheet and the first variable in that sheet.

How you invoke this form

Invoke this form at the end of a simulation when the "End Simulation" screen appears. Click on the "View Results" button.

You can invoke this form and view results at any time by double-clicking on a results file item in the **Item List** when the "Results file" node of the **Object Tree** is selected.

Purpose and Function

The purpose of this form is to navigate, view and print results and their associated tables and graphics. Results can be exported from this form to MS Excel files.

Navigating the Results

You navigate among the results by selecting the result variable sheet with the pull-down menu in the upper right-hand corner of the screen. After selecting the result variable sheet, use the up and down arrows to find the variable of interest. Alternatively, you can scroll or point-and-click to the variable of interest in the results data grid at the bottom of the screen.

When a result is selected its statistics are shown in the tables on the form as well as a chart of the table values. Using the option buttons you can choose to display the summary chart as a cumulative, de-cumulative or probability density chart. The summary charts do not use all of the simulation data, rather, only the summary statistics in the tables are plotted in the charts. The full-screen charts plot all of the simulation result data from all trials of the simulation. To view these, press the "Full-Screen Charts" button after selecting the result variable of interest. (See Full Screen Charts Form 9.1 and Tornado Charts Form 9.2

Export and Print

Export to an MS-Excel spreadsheet and print the screen using the icons in the toolbar.

View Charts Ranking

Clicking on the railroad crossing sign icon launches the Benefit Ranking by Crossing Form (9.3). See description below.

Print Results Variable Report

Next to the report icon is a pull-down menu with print report options. The results variable report is a one-page report with tables and charts of the selected result variable (see sample reports in Appendix 1).

View Results File Report

The results file report includes results tables of percentiles and summary statistics for every result variable in the results file being viewed (see sample reports in Appendix 1).

Data Elements

With this form you view stored simulation results from the selected resx.mdb file.

Full-Screen Charts Form (9.1)

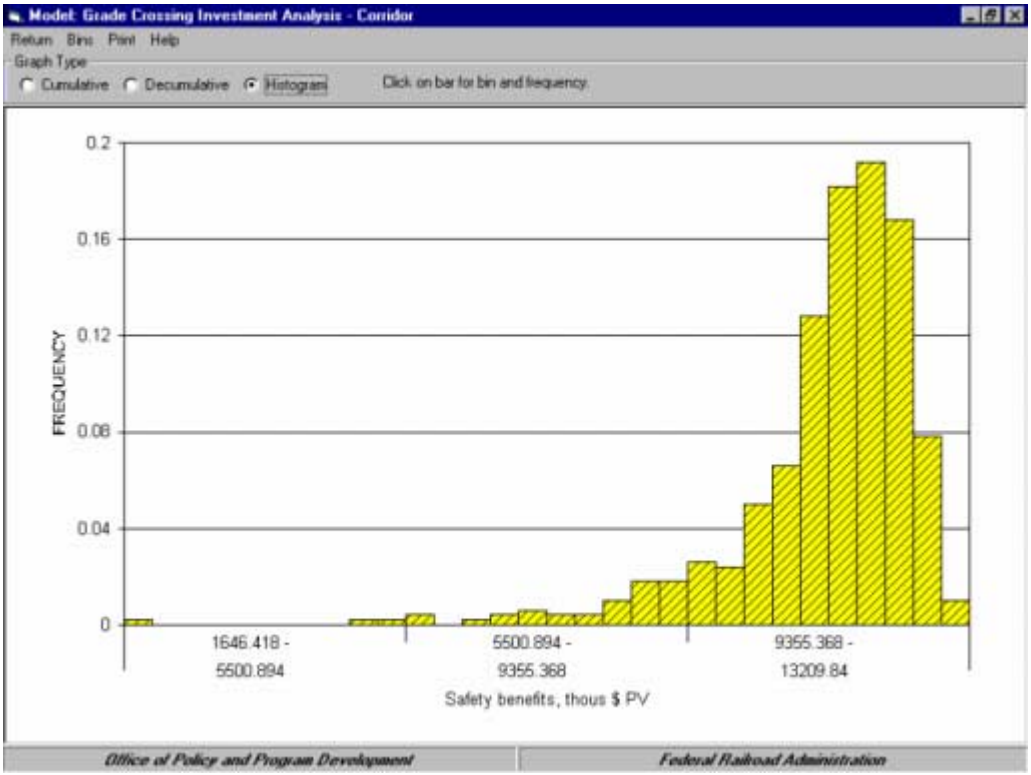

Figure 22 Full-Screen Charts Form

Description

The full-screen charts display all of a result's values from each trial of a simulation.

How you invoke this form

You invoke this form from the button “Full-Screen Charts” on the Results form.

Purpose and Function

When the form is invoked a histogram chart of the selected result variable is displayed with its values distributed into 30 probability bins. You can modify the granularity of the histogram by changing the number of bins using the “Bins” option in the form menu. By pointing and clicking on a particular bin you can view the probability of the result falling within the bin’s range.

Choose the “De-cumulative” option button to view the de-cumulative probability chart. This chart shows the full range of values for the selected result and the probability of exceeding each value in its range. Pointing and clicking on a point of the curve will display the coordinates of that point. You can move to adjacent points after displaying a point by pressing the “n” key (for next) or “p” key (for previous).

The cumulative probability chart is displayed when you press the "Cumulative" option button on the form.

Data Elements

The Full-Screen charts form displays the simulation results that are stored in the SimRes table of resx.mdb database.

Tornado Chart Form (9.2)

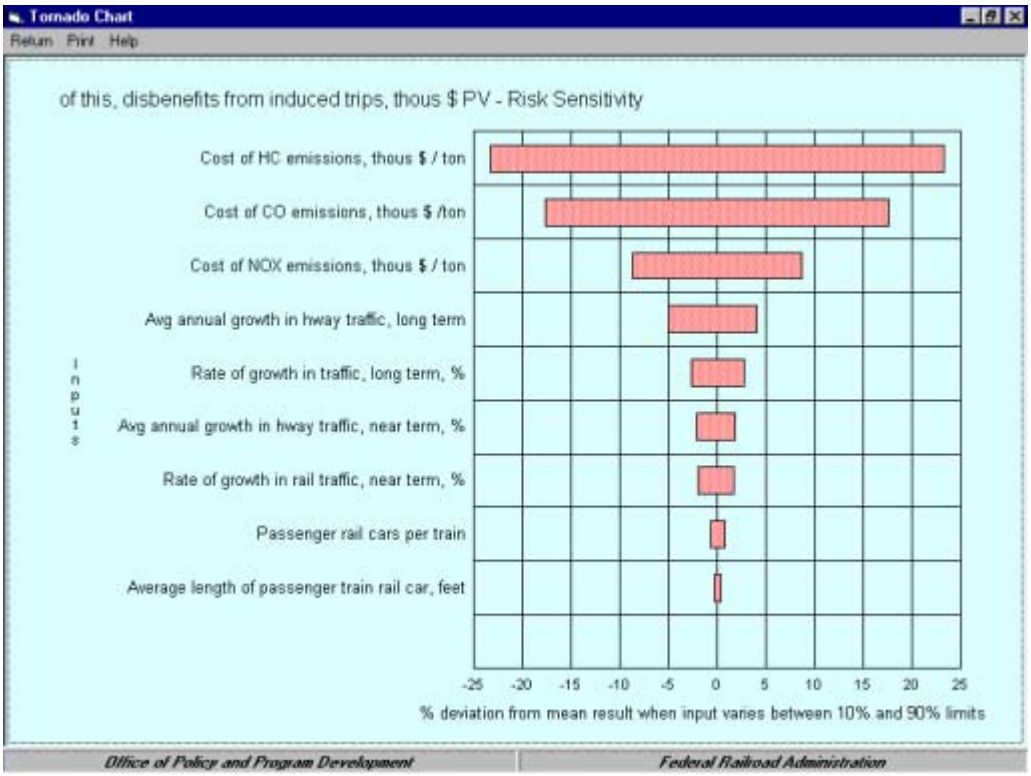

Figure 23 Tornado Chart Form

Description

The tornado chart displays the sensitivity of the risk of a result to the input variables.

How you invoke this form

You invoke this form by pressing the button "Tornado Chart" on the Results form.

Purpose and Function

An input variable contributes to risk by means of: a) its own variance , and, b) its structural role in the *GradeDec 2000* model. For instance, an input variable with large variance may not be a significant contributor to the risk of a result while an

input variable with small variance may cause the result to be very uncertain and risky. Without the analysis of risk sensitivity it is not easy to determine which factors are the significant contributors to the riskiness of a particular result.

The tornado chart shows the impact of each random variable input factor when all the other input factors are set to their mean values and the single input factor is allowed to vary within its 80% confidence interval. The tornado chart displays in order the ten input variables that are the major contributors to the risk of a result.

This analysis of sensitivity can guide the analyst to focus on refining the estimates on the range of input variables that truly matter, and, help decisions makers plan for mitigating risks.

Data Elements

The tornado chart displays values from the risk sensitivity analysis that were stored in the Sens table in the resx.mdb database.

Benefit Ranking by Crossing Form (9.3)

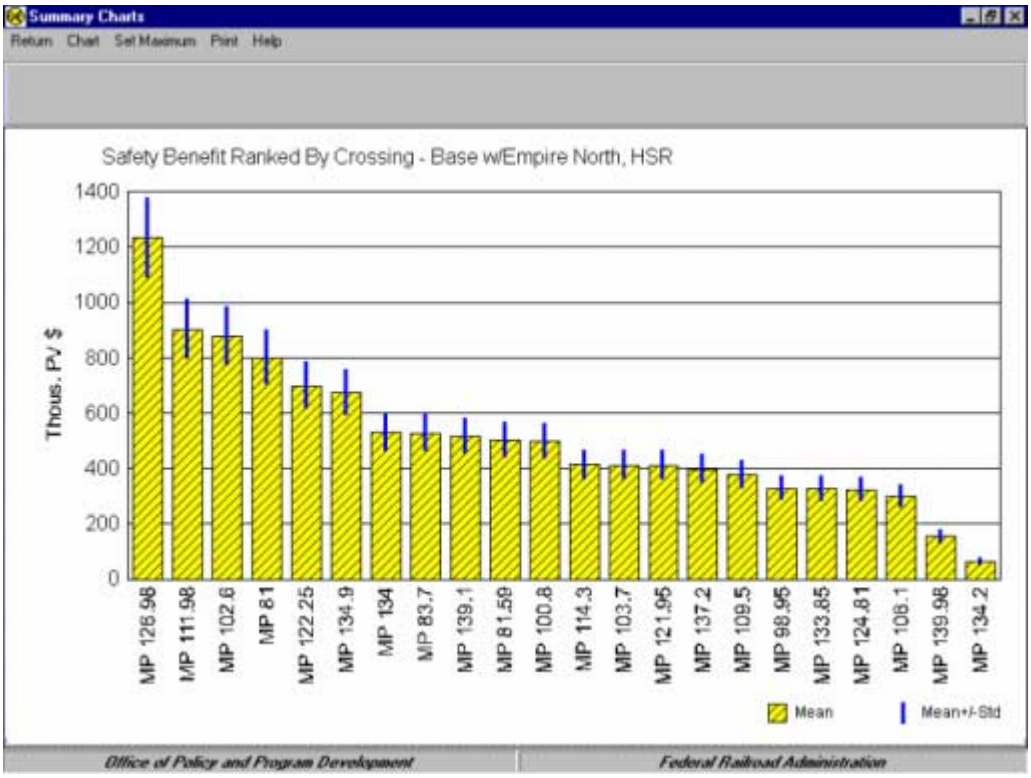

Figure 24 Ranked Bars of Benefits by Crossing with Mean and Mean Plus/Minus Standard Deviation

Description

This form contains a series of charts that illustrate the rankings of the crossings by benefits. The user can choose to rank crossings either by safety benefits only or total benefits.

How you invoke this form

You invoke this form by clicking on the railroad crossing warning icon on the toolbar in the results form.

Purpose and Function

The set of charts in this form is designed to support resource allocation decisions. The charts illustrate the relative magnitude of benefits, the riskiness of the benefits, how the ranked crossings compare with one another and the cumulative benefits from crossing improvements.

One chart also compares the ranked benefits by crossing with the costs by crossing. This view of the benefits and costs assists users to quickly identify high yield improvements and to develop improvement programs accordingly.

Data Elements

The charts display benefit and cost results that are stored in the selected results file.

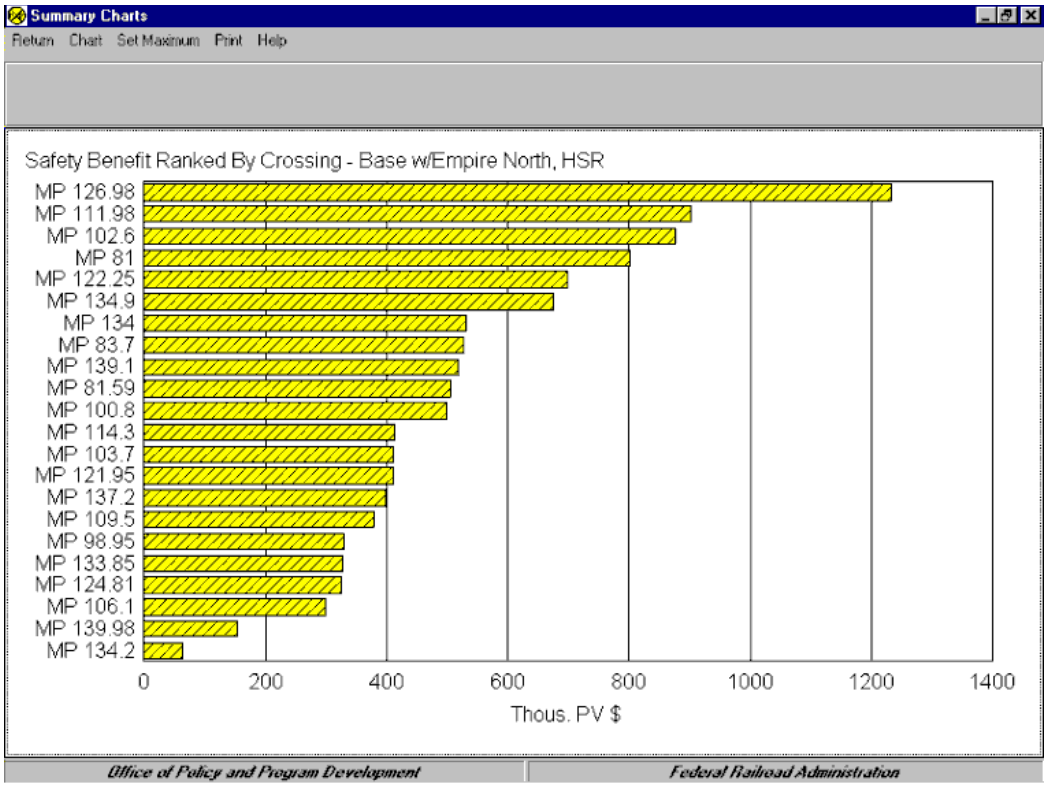

Figure 25 Ranked Horizontal Bars of Benefits by Crossing

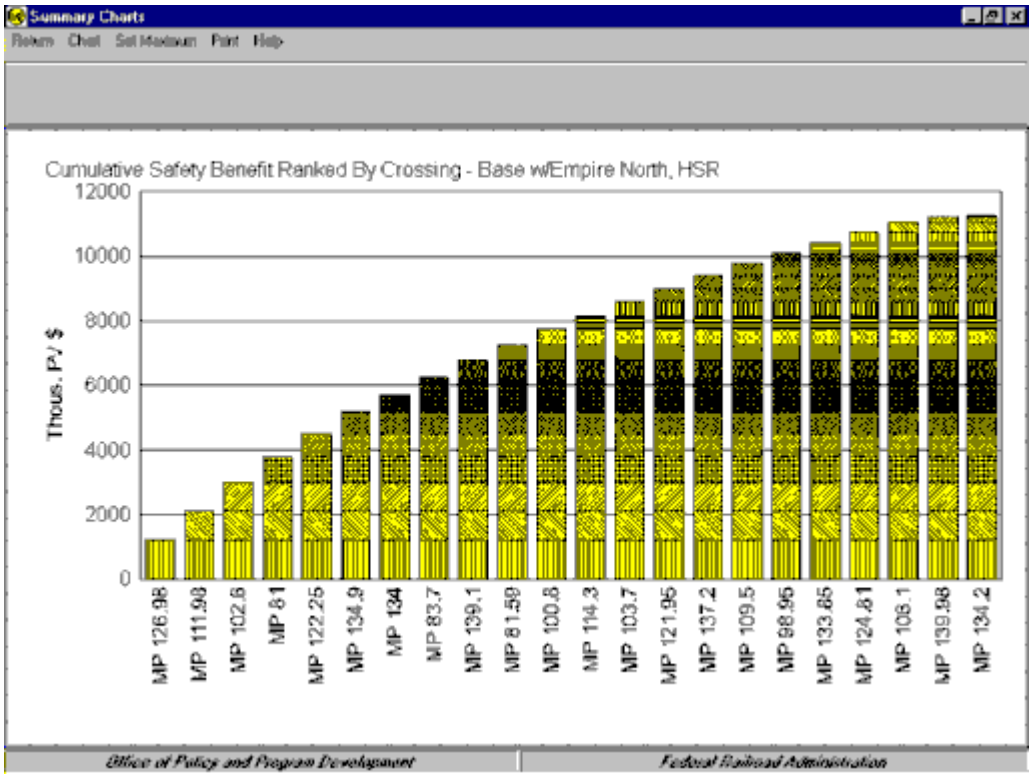

Figure 26 Ranked Bars with Cumulative Benefit

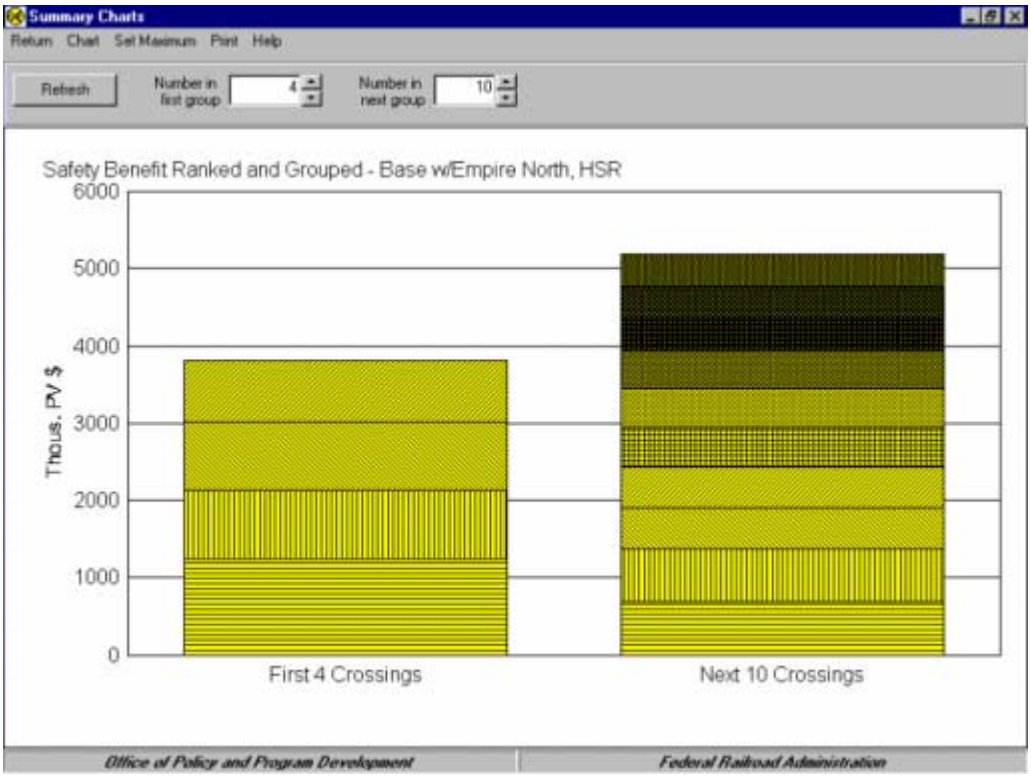

Figure 27 Crossings Ranked by Benefit Stacked by First n Crossings and Next m Crossings

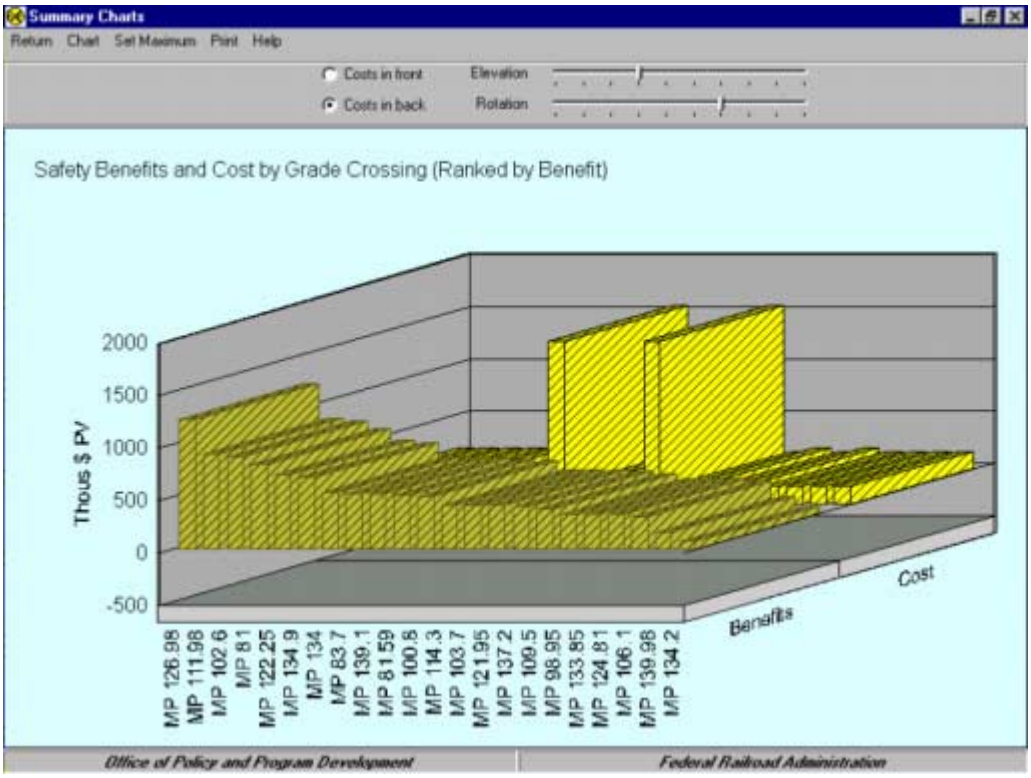

Figure 28 Crossings Ranked by Benefit shown with Costs

Glossary of Terms

Bins

The range for a simulation result variable, that is, the values bounded by its minimum and maximum values, is divided into equal portions called bins. The result value from each trial "falls" into one of these bins. Charting the result value's range on the horizontal axis and the probability of a result value falling in the bins yields the histogram chart.

Cumulative Probability Distribution

A cumulative probability distribution is constructed by cumulating the frequency of the probability density function. A cumulative probability distribution is an "upwardly sloping" curve, where each point on the curve gives the probability that the variable will be equal to or less than the value on the x-axis. The y-axis of the cumulative probability distribution ranges between 0 and 1. The cumulative probability distribution equals zero for a variable's minimum value and rises to 1 at a variable's maximum value.

De-cumulative Probability Distribution

A de-cumulative probability distribution is constructed by subtracting (or de-cumulating) a variable's probability frequency starting with a probability of 1. A de-cumulative probability distribution is a "downward sloping" curve, where the curve gives the probability of the variable exceeding the value along the X-axis. The de-cumulative probability is 1 for a variable's minimum value and is 0 for its maximum value (i.e., the y-axis ranges between 1 and 0).

Deterministic

The term deterministic indicates that there is no uncertainty associated with a given value, variable or model. Models that include random variables are called stochastic.

Histogram

A histogram shows the frequency of a discrete random variable and is used to display the frequency distribution of Monte Carlo simulation result variables. In a histogram, the result values are gathered in bins and the height of the bars correspond to the frequency with which values fall in the respective bins.

Kurtosis

Kurtosis is a statistical measure of a distribution's peakedness. Flatter distributions (with thin tails) are called platykurtic and peaked distributions (with fat tails) are called leptokurtic. The formula for kurtosis is:

$$\frac{1}{n}\frac{\sum_i (x_i - \mu)^4}{\sigma^4} - 3$$

Latin Hypercube

Latin Hypercube is an alternative statistical sampling method to the Monte Carlo method. This is a stratified sampling method, which means that the range for each input variable is divided into strata and one random sample is taken from each stratum. This method ensures faster convergence to the result distribution than with the Monte Carlo sampling method.

Lower 10% Value

The lower 10% value is the 10th percentile value and is the lower limit of an 80% confidence interval as input by the user.

Mean Value

The mean value for a collection of observations of a random variable is its mean expected value and equals the sum of the observations divided by the number of observations. For skewed distributions, the mean value is off the median value and is located in the direction of the distribution's skew.

Median Value

The median value is the 50th percentile: there is equal probability that the value for a random variable will lie above or below the median.

Mode

The mode of a probability distribution is the value for which the probability density function is at a maximum. The value has the highest probability (and is sometimes called "the most likely value", not to be confused with the mean or expected value).

Monte Carlo

Monte Carlo is the method of sampling from random variables by taking a random number on the 0-1 interval , call it *a,* and finding the value of the random variable whose cumulative probability equals *a*. Repeated Monte Carlo sampling on a number of random variables that are inputs to a model and repeatedly solving the model to arrive at probability distributions for the result variables is called Monte Carlo simulation.

Probability

Probability is the likelihood that a value or event will occur.

Probability Distribution

A probability distribution or probability density function shows a continuous random variable's frequency of occurrence over its range.

Probability Density Function

Same as probability distribution.

Risk

The term refers to uncertainty in a forecast outcome. Colloquially, risk is often associated with undesirable or downside outcomes (as in "hedging against risk"). In a risk analysis, risk is reflected in the probability distributions of result variables.

Risk Analysis

Risk analysis is a term applied to several methods for quantifying uncertainty in forecasts. The risk analysis method used in GradeDec 2000 is called Monte Carlo simulation.

Random seed

The random seed is a number that initializes the generation of random numbers used in a Monte Carlo simulation. For the same random seed and the same number of trials -- given no change in the model or inputs -- the results of two Monte Carlo simulations will be identical.

Simulation

Simulation is a numeric method for finding solutions to analytically complex problems by "simulating" repeated, real world occurrences.

Skewness

Skewness is a measure of the asymmetry of a distribution. The probability density function of a skewed distribution has a longer tail on its skewed side. A right skewed distribution has skewness greater than 0 and a left skewed distribution has skewness less than 0. The formula for skewness is:

$$\frac{1}{n}\frac{\sum_i (x_i - \mu)^3}{\sigma^3}$$

Standard Deviation

The standard deviation, which is the square root of the variance, is the principal descriptive statistic after the mean value. Knowing only a distribution's mean value and standard deviation, an upper bound can be found on the probability of any value in a variable's range.

Trial

A trial is one solution of a model in a simulation. A simulation consists of many trials. In each trial, every input variable is populated with a data value sampled from the variable's probability distribution.

Upper 10% Value

The upper 10% value is the 90th percentile of a probability distribution and the upper limit of an 80% confidence interval.

Variable

A variable is a model element that can assume more than one value. A fixed-value input variable can assume only one value. A random variable can assume a range of values according to its probability distribution.

Variable data grid

The bottom portion of the Scenario Data Input form. Use this section of the form either to navigate or view the stored values for the input variable.

Variance

The variance is a measure of the dispersion of values in a probability distribution, and is a measure of risk. The variance is the average of the squared deviations about the mean. The variance gives disproportionate weight to “outliers,” values that are far away from the mean. The variance is the square of the standard deviation.

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Appendix

GradeDec 2000 Reports

Corridor Report – DOT Model

Corridor Report – HSR Model

Region Report

Scenario Report

Result Variable Report

Result File Report

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC 2000 - CORRIDOR MODEL

CORRIDOR DATA

Corridor ID	3	Average Number of Passenger Trains / Day	68.0
Corridor Name	Empire South	Average Number of Freight Trains / Day	0.0
Rail Traffic Time-of-Day Dist	Day Flat	Average Number of Switch Trains / Day	0.0
Technology Factor	0.50	Signal Synchronization	False

CROSSING DATA FOR THE EMPIRE SOUTH CORRIDOR

Milepost	46.04	H'way Lanes	2	Accidents in 5 Years		1.00
Description	Manitou	Distance from Highway	1.0	Predicted Annual Accidents		
Paved?	True				*Base*	*Alternate*
Urban?	True	AADT	167	Fatal	0.01197	0.00598
GCX Base Type	Flashing Lights and Gates	Auto Time-of-day Dist	Day Flat	Injury	0.01693	0.00847
GCX Alt Type	New Technology			PDO	0.04878	0.02439
No. RR Tracks	2	Percent Trucks	27.4			
		Of this, % trailers	28.80	Costs in '000 $		
	Train Speeds (mph)	Truck Time-of-day Dist	Day Flat	Base - O&M		2.5
Max Timetable	80.0			Base - Other Lifecycle		0.0
Passenger	80.00	Percent Bus	0.00	Alt. - Capital Cost		180.0
Freight	15.00	Bus Time-of-day Dist	Day Flat	Alt. - O&M		0.5
Switch	10.00			Alt. - Other Lifecyle		0.0

Milepost	47.40	H'way Lanes	2	Accidents in 5 Years		0.00
Description	King's Dock	Distance from Highway	0.5	Predicted Annual Accidents		
Paved?	False				*Base*	*Alternate*
Urban?	True	AADT	2	Fatal	0.00222	0.00156
GCX Base Type	Passive Grade Crossing	Auto Time-of-day Dist	Day Flat	Injury	0.00314	0.00220
GCX Alt Type	New Technology			PDO	0.00906	0.00634
No. RR Tracks	2	Percent Trucks	27.4			
		Of this, % trailers	28.80	Costs in '000 $		
	Train Speeds (mph)	Truck Time-of-day Dist	Day Flat	Base - O&M		0.2
Max Timetable	80.0			Base - Other Lifecycle		0.0
Passenger	80.00	Percent Bus	0.00	Alt. - Capital Cost		180.0
Freight	15.00	Bus Time-of-day Dist	Day Flat	Alt. - O&M		0.5
Switch	10.00			Alt. - Other Lifecyle		0.0

Milepost	62.55	H'way Lanes	2	Accidents in 5 Years		0.00
Description	Bank St.	Distance from Highway	0.5	Predicted Annual Accidents		
Paved?	True				*Base*	*Alternate*
Urban?	True	AADT	281	Fatal	0.00481	0.00000
GCX Base Type	Flashing Lights and Gates	Auto Time-of-day Dist	PM Peak	Injury	0.00681	0.00000
GCX Alt Type	Grade Separation			PDO	0.01961	0.00000
No. RR Tracks	2	Percent Trucks	27.4			
		Of this, % trailers	28.80	Costs in '000 $		
	Train Speeds (mph)	Truck Time-of-day Dist	PM Peak	Base - O&M		2.5
Max Timetable	80.0			Base - Other Lifecycle		0.0
Passenger	80.00	Percent Bus	0.00	Alt. - Capital Cost		1,500.0
Freight	15.00	Bus Time-of-day Dist	PM Peak	Alt. - O&M		0.5
Switch	10.00			Alt. - Other Lifecyle		0.0

CROSSING DATA FOR THE EMPIRE SOUTH CORRIDOR

Milepost	71.00	H'way Lanes	2	Accidents in 5 Years		1.00
Description	Pirate Canoe	Distance from Highway	0.5	Predicted Annual Accidents		
Paved?	True				*Base*	*Alternate*
Urban?	True	AADT	50	Fatal	0.02488	0.01742
GCX Base Type	Passive Grade Crossing	Auto Time-of-day Dist	Day Flat	Injury	0.03096	0.02167
GCX Alt Type	New Technology			PDO	0.09051	0.06336
No. RR Tracks	2	Percent Trucks	27.4			
		Of this, % trailers	28.80	Costs in '000 $		
Train Speeds (mph)		Truck Time-of-day Dist	Day Flat	Base - O&M		0.2
Max Timetable	90.0			Base - Other Lifecycle		0.0
Passenger	90.00	Percent Bus	0.00	Alt. - Capital Cost		180.0
Freight	15.00	Bus Time-of-day Dist	Day Flat	Alt. - O&M		0.5
Switch	10.00			Alt. - Other Lifecyle		0.0

Milepost	75.95	H'way Lanes	2	Accidents in 5 Years		0.00
Description	Captains 3	Distance from Highway	0.5	Predicted Annual Accidents		
Paved?	True				*Base*	*Alternate*
Urban?	True	AADT	50	Fatal	0.00359	0.00180
GCX Base Type	Flashing Lights and Gates	Auto Time-of-day Dist	Day Flat	Injury	0.00447	0.00223
GCX Alt Type	New Technology			PDO	0.01307	0.00653
No. RR Tracks	2	Percent Trucks	27.4			
		Of this, % trailers	28.80	Costs in '000 $		
Train Speeds (mph)		Truck Time-of-day Dist	Day Flat	Base - O&M		2.5
Max Timetable	90.0			Base - Other Lifecycle		0.0
Passenger	90.00	Percent Bus	0.00	Alt. - Capital Cost		180.0
Freight	15.00	Bus Time-of-day Dist	Day Flat	Alt. - O&M		0.5
Switch	10.00			Alt. - Other Lifecyle		0.0

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC 2000 - CORRIDOR MODEL WITH HSR

CORRIDOR DATA

Corridor ID	3	Average Number of Passenger Trains / Day	68.00
Corridor Name	Empire South	Average Number of Freight Trains / Day	0.00
Rail Traffic Time-of-Day Dist	Day Flat	Average Number of Switch Trains / Day	0.00
Technology Factor	0.50	Signal Synchronization	False

CROSSING DATA FOR THE EMPIRE SOUTH CORRIDOR

Milepost:	46.04	H'way Lanes	2	Predicted Annual Accidents and their Severity	
Description	Manitou	Distance from H'way	1.0	*Base Case*	*Alt. Case*
Paved?	True	AADT	167	Fatalities	
Urban?	True	Auto Time-of-day Dist	Day Flat	on highway	0.02258	0.00564
GCX Base Type	Flashing Lights and Gates	Percent Trucks	27.4	on train	0.00234	0.00059
GCX Alt Type	New Technology	of these, percent trailers	28.8	Total	0.02492	0.00623
Costs in '000 $		Truck Time-of-day Dist	Day Flat	Injuries	
Base - O&M	2.5	Percent Bus	0.00	on highway	0.04064	0.01016
Base - Other Lifecycle	0.0	Bus Time-of-day Dist	Day Flat	on train	0.00421	0.00105
Alt. - Capital Cost	180.0	No. RR Tracks	2	Total	0.04486	0.01121
Alt. - O&M:	0.5	Train speed, pass.	80.0			
Alt. - Other Lifecyle	0.0	Train speed, freight	15.0	No. Accidents	0.04469	0.01117
		Train speed, switch	10.0			

Milepost:	47.40	H'way Lanes	2	Predicted Annual Accidents and their Severity	
Description	King's Dock	Distance from H'way	0.5	*Base Case*	*Alt. Case*
Paved?	False	AADT	2	Fatalities	
Urban?	True	Auto Time-of-day Dist	Day Flat	on highway	0.00999	0.00154
GCX Base Type	Passive Grade Crossing	Percent Trucks	27.4	on train	0.00104	0.00016
GCX Alt Type	New Technology	of these, percent trailers	28.8	Total	0.01102	0.00170
Costs in '000 $		Truck Time-of-day Dist	Day Flat	Injuries	
Base - O&M	0.2	Percent Bus	0.00	on highway	0.01797	0.00277
Base - Other Lifecycle	0.0	Bus Time-of-day Dist	Day Flat	on train	0.00186	0.00029
Alt. - Capital Cost	180.0	No. RR Tracks	2	Total	0.01984	0.00305
Alt. - O&M:	0.5	Train speed, pass.	80.0			
Alt. - Other Lifecyle	0.0	Train speed, freight	15.0	No. Accidents	0.01976	0.00304
		Train speed, switch	10.0			

Milepost:	62.55	H'way Lanes	2	Predicted Annual Accidents and their Severity	
Description	Bank St.	Distance from H'way	0.5	*Base Case*	*Alt. Case*
Paved?	True	AADT	281	Fatalities	
Urban?	True	Auto Time-of-day Dist	PM Peak	on highway	0.02569	0.00000
GCX Base Type	Flashing Lights and Gates	Percent Trucks	27.4	on train	0.00266	0.00000
GCX Alt Type	Grade Separation	of these, percent trailers	28.8	Total	0.02836	0.00000
Costs in '000 $		Truck Time-of-day Dist	PM Peak	Injuries	
Base - O&M	2.5	Percent Bus	0.00	on highway	0.04625	0.00000
Base - Other Lifecycle	0.0	Bus Time-of-day Dist	PM Peak	on train	0.00480	0.00000
Alt. - Capital Cost	1,500.0	No. RR Tracks	2	Total	0.05104	0.00000
Alt. - O&M:	0.5	Train speed, pass.	80.0			
Alt. - Other Lifecyle	0.0	Train speed, freight	15.0	No. Accidents	0.05085	0.00000
		Train speed, switch	10.0			

CROSSING DATA FOR THE EMPIRE SOUTH CORRIDOR

Milepost:	71.00	H'way Lanes	2	Predicted Annual Accidents and their Severity	
Description	Pirate Canoe	Distance from H'way	0.5	*Base Case*	*Alt. Case*
Paved?	True	AADT	50	Fatalities	
Urban?	True	Auto Time-of-day Dist	Day Flat	on highway	0.06441	0.00396
GCX Base Type	Passive Grade Crossing	Percent Trucks	27.4	on train	0.00840	0.00052
GCX Alt Type	New Technology	of these, percent trailers	28.8	Total	0.07281	0.00447
Costs in '000 $		Truck Time-of-day Dist	Day Flat	Injuries	
Base - O&M	0.2	Percent Bus	0.00	on highway	0.11594	0.00713
Base - Other Lifecycle	0.0	Bus Time-of-day Dist	Day Flat	on train	0.01512	0.00093
Alt. - Capital Cost	180.0	No. RR Tracks	2	Total	0.13106	0.00805
Alt. - O&M:	0.5	Train speed, pass.	90.0			
Alt. - Other Lifecyle	0.0	Train speed, freight	15.0	No. Accidents	0.12748	0.00784
		Train speed, switch	10.0			

Milepost:	75.95	H'way Lanes	2	Predicted Annual Accidents and their Severity	
Description	Captains 3	Distance from H'way	0.5	*Base Case*	*Alt. Case*
Paved?	True	AADT	50	Fatalities	
Urban?	True	Auto Time-of-day Dist	Day Flat	on highway	0.01584	0.00396
GCX Base Type	Flashing Lights and Gates	Percent Trucks	27.4	on train	0.00206	0.00052
GCX Alt Type	New Technology	of these, percent trailers	28.8	Total	0.01790	0.00447
Costs in '000 $		Truck Time-of-day Dist	Day Flat	Injuries	
Base - O&M	2.5	Percent Bus	0.00	on highway	0.02850	0.00713
Base - Other Lifecycle	0.0	Bus Time-of-day Dist	Day Flat	on train	0.00372	0.00093
Alt. - Capital Cost	180.0	No. RR Tracks	2	Total	0.03222	0.00805
Alt. - O&M:	0.5	Train speed, pass.	90.0			
Alt. - Other Lifecyle	0.0	Train speed, freight	15.0	No. Accidents	0.03134	0.00784
		Train speed, switch	10.0			

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC 2000 - REGIONAL MODEL

REGION
Region ID: 3
Region Name: Montgomery County, Maryland
Technology Factor: 0.50

CROSSING DATA FOR THE MONTGOMERY COUNTY, MARYLAND REGION

Crossing ID	140488D	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	971	No. Other Tracks	0	Last year	0		*Base*	*Alternate*
Description	CSX - FOREST GLEN RD	Train Speed		2 years ago	0	Fatal	0.00592	0.00295
		Day Through Trains	14.0	3 years ago	0	Injury	0.01320	0.00659
Paved?	True	Night Through Trains	22.0	4 years ago	0	PDO	0.03669	0.01835
Urban?	True	Day Switch Trains	0.0	5 years ago	0			
GCX Base Type	Gates	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	New technology	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		2.50
H'way Lanes	2			Maximum		Base - Other Li'cycle		0.00
AADT	11400	Auto Time-of-day Dist	Uniform	timetable	55.0	Alt. - Capital Cost:		180.00
Percent Trucks	3.00	Truck Time-of-day Dist	Uniform	Thru	55.0	Alt. - O&M		0.50
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	11.0	Alt. - Other L'cyle		0.00

Crossing ID	140494G	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	1377	No. Other Tracks	0	Last year	0		*Base*	*Alternate*
Description	CSX - RANDOLPH ROAD	Train Speed		2 years ago	1	Fatal	0.03541	0.00000
		Day Through Trains	19.0	3 years ago	0	Injury	0.05629	0.00000
Paved?	True	Night Through Trains	10.0	4 years ago	0	PDO	0.15545	0.00000
Urban?	True	Day Switch Trains	0.0	5 years ago	1			
GCX Base Type	Gates	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	Grade separation	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		2.50
H'way Lanes	4			Maximum		Base - Other Li'cycle		0.00
AADT	41000	Auto Time-of-day Dist	Uniform	timetable	79.0	Alt. - Capital Cost:		1,500.00
Percent Trucks	9.00	Truck Time-of-day Dist	Uniform	Thru	79.0	Alt. - O&M		0.50
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	15.8	Alt. - Other L'cyle		0.00

Crossing ID	140505S	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	2050	No. Other Tracks	0	Last year	0		*Base*	*Alternate*
Description	CSX - RIDGE RD.	Train Speed		2 years ago	0	Fatal	0.02526	0.01263
		Day Through Trains	14.0	3 years ago	0	Injury	0.03913	0.01956
Paved?	True	Night Through Trains	22.0	4 years ago	1	PDO	0.10913	0.05456
Urban?	True	Day Switch Trains	0.0	5 years ago	1			
GCX Base Type	Gates	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	New technology	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		2.50
H'way Lanes	2			Maximum		Base - Other Li'cycle		0.00
AADT	4000	Auto Time-of-day Dist	Uniform	timetable	79.0	Alt. - Capital Cost:		180.00
Percent Trucks	4.00	Truck Time-of-day Dist	Uniform	Thru	79.0	Alt. - O&M		0.50
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	15.8	Alt. - Other L'cyle		0.00

Crossing ID	140507F	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	2179	No. Other Tracks	0	Last year	0		*Base*	*Alternate*
Description	CSX - S SUMMIT AVE	Train Speed		2 years ago	0	Fatal	0.00879	0.00440
		Day Through Trains	14.0	3 years ago	0	Injury	0.01362	0.00682
Paved?	True	Night Through Trains	22.0	4 years ago	0	PDO	0.03798	0.01899
Urban?	True	Day Switch Trains	0.0	5 years ago	0			
GCX Base Type	Gates	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	New technology	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		2.50
H'way Lanes	3			Maximum		Base - Other Li'cycle		0.00
AADT	11300	Auto Time-of-day Dist	Uniform	timetable	79.0	Alt. - Capital Cost:		180.00
Percent Trucks	5.00	Truck Time-of-day Dist	Uniform	Thru	79.0	Alt. - O&M		0.50
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	15.8	Alt. - Other L'cyle		0.00

CROSSING DATA FOR THE MONTGOMERY COUNTY, MARYLAND REGION

Crossing ID	140509U	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	2213	No. Other Tracks	0	Last year	0		*Base*	*Alternate*
Description	CSX - CHESTNUT ST.	Train Speed		2 years ago	0	Fatal	0.00676	0.00338
		Day Through Trains	14.0	3 years ago	0	Injury	0.01279	0.00640
Paved?	True	Night Through Trains	22.0	4 years ago	0	PDO	0.03544	0.01773
Urban?	True	Day Switch Trains	0.0	5 years ago	0			
GCX Base Type	Gates	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	New technology	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		2.50
H'way Lanes	2			Maximum		Base - Other Li'cycle		0.00
AADT	10500	Auto Time-of-day Dist	Uniform	timetable	65.0	Alt. - Capital Cost:		180.00
Percent Trucks	4.00	Truck Time-of-day Dist	Uniform	Thru	65.0	Alt. - O&M		0.50
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	13.0	Alt. - Other L'cyle		0.00

Crossing ID	140519A	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	3310	No. Other Tracks	0	Last year	0		*Base*	*Alternate*
Description	CSX - HILLRISE LANE	Train Speed		2 years ago	0	Fatal	0.00666	0.00433
		Day Through Trains	14.0	3 years ago	0	Injury	0.01031	0.00670
Paved?	False	Night Through Trains	22.0	4 years ago	0	PDO	0.02876	0.01870
Urban?	True	Day Switch Trains	0.0	5 years ago	0			
GCX Base Type	Crossbucks	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	Flashing lights	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		0.20
H'way Lanes	2			Maximum		Base - Other Li'cycle		0.00
AADT	200	Auto Time-of-day Dist	Uniform	timetable	79.0	Alt. - Capital Cost:		74.80
Percent Trucks	1.00	Truck Time-of-day Dist	Uniform	Thru	79.0	Alt. - O&M		1.80
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	15.8	Alt. - Other L'cyle		0.00

Crossing ID	140524W	No. Main Tracks	0	No. of Accidents		Predicted Annual Accidents		
Milepost:	3700	No. Other Tracks	1	Last year	0		*Base*	*Alternate*
Description	CSX - MOUTHOFMONOCACY RD	Train Speed		2 years ago	0	Fatal	0.00016	0.00010
		Day Through Trains	0.0	3 years ago	0	Injury	0.00257	0.00156
Paved?	True	Night Through Trains	0.0	4 years ago	0	PDO	0.00835	0.00510
Urban?	True	Day Switch Trains	2.0	5 years ago	0			
GCX Base Type	Crossbucks	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	Flashing lights	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		0.20
H'way Lanes	2			Maximum		Base - Other Li'cycle		0.00
AADT	400	Auto Time-of-day Dist	Uniform	timetable	10.0	Alt. - Capital Cost:		74.80
Percent Trucks	1.00	Truck Time-of-day Dist	Uniform	Thru	10.0	Alt. - O&M		1.80
Percent Bus	0.00	Bus Time-of-day Dist	Uniform	Switch	2.0	Alt. - Other L'cyle		0.00

Crossing ID	140512C	No. Main Tracks	2	No. of Accidents		Predicted Annual Accidents		
Milepost:	2336	No. Other Tracks	0	Last year	1		*Base*	*Alternate*
Description	CSX - METROPOLITANGROV E	Train Speed		2 years ago	0	Fatal	0.01124	0.00562
		Day Through Trains	14.0	3 years ago	0	Injury	0.01742	0.00871
Paved?	True	Night Through Trains	22.0	4 years ago	0	PDO	0.04858	0.02429
Urban?	True	Day Switch Trains	0.0	5 years ago	0			
GCX Base Type	Gates	Night Switch Trains	0.0			Costs in '000 $		
GCX Alt Type	New technology	Rail Time-of-day Dist	Uniform	Train Speeds (mph)		Base - O&M		2.50
H'way Lanes	2			Maximum		Base - Other Li'cycle		0.00
AADT	600	Auto Time-of-day Dist	AM Peak	timetable	79.0	Alt. - Capital Cost:		180.00
Percent Trucks	2.00	Truck Time-of-day Dist	AM Peak	Thru	79.0	Alt. - O&M		0.50
Percent Bus	0.00	Bus Time-of-day Dist	AM Peak	Switch	15.8	Alt. - Other L'cyle		0.00

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC 2000 - CORRIDOR MODEL - SCENARIO DATA

Scenario ID	1	First Year	2000
Description	Strong rail growth	Last Year Near Term	2004
		Last Year	2019

STRONG RAIL GROWTH SCENARIO DATA

Variable Description	Prob. Distribution Type			
Rail Operations				
		Lower 10%	**Median**	**Upper 10%**
Rate of growth in rail traffic, near term, %	Skewed Bell	2.60000	2.95000	3.30000
		Lower 10%	**Median**	**Upper 10%**
Rate of growth in traffic, long term, %	Skewed Bell	1.30000	2.00000	2.50000
		Mean - std	**Mean**	**Mean + std**
Freight rail cars per train	Normal	35.0000	45.0000	55.0000
		Min Value	**Most Likely**	**Max Value**
Passenger rail cars per train	Triangle	5.50000	6.00000	6.50000
			Fixed Value	
Switch cars per train	Fixed Value		5.00000	
		Lower 10%	**Median**	**Upper 10%**
Average length of freight rail car, feet	Skewed Bell	53.0000	55.0000	58.0000
		Lower 10%	**Median**	**Upper 10%**
Average length of passenger train rail car, feet	Skewed Bell	37.0000	40.0000	43.5000
		Min Value		**Max Value**
Average length of switch train car, feet	Uniform	60.0000		75.0000
Highway				
		Lower 10%	**Median**	**Upper 10%**
Avg annual growth in hway traffic, near term, %	Skewed Bell	2.00000	2.50000	2.80000
		Lower 10%	**Median**	**Upper 10%**
Avg annual growth in hway traffic, long term	Skewed Bell	0.700000	1.00000	1.80000
		Lower 10%	**Median**	**Upper 10%**
Average auto vehicle occupancy	Skewed Bell	1.47600	1.64000	1.80400
		Lower 10%	**Median**	**Upper 10%**
Avg bus vehicle occupancy	Skewed Bell	9.00000	10.0000	11.0000
			Fixed Value	
Annualization factor	Fixed Value		280.000	
			Fixed Value	
Elasticity of auto AADT w.r.t. generalized cost of travel	Fixed Value		-0.100000	
			Fixed Value	
Average % of auto trip costs that are GCX-related, percent	Fixed Value		2.50000	

STRONG RAIL GROWTH SCENARIO DATA

Variable Description	Prob. Distribution Type			
Social Costs				
			Fixed Value	
Discount rate, %	Fixed Value		5.00000	
		Lower 10%	**Median**	**Upper 10%**
Cost of a fatal accident, thous $	Skewed Bell	3500.00	3800.00	4500.00
		Lower 10%	**Median**	**Upper 10%**
Cost of an injury accident, thous $	Skewed Bell	800.000	1000.00	1400.00
		Lower 10%	**Median**	**Upper 10%**
Cost of a property damage only accident, thous $	Skewed Bell	40.0000	50.0000	90.0000
		Lower 10%	**Median**	**Upper 10%**
Cost per fatality (for HSR Model), thous $	Skewed Bell	2200.00	2700.00	2900.00
		Lower 10%	**Median**	**Upper 10%**
Cost per injury (for HSR model), thous $	Skewed Bell	180.000	250.000	300.000
		Lower 10%	**Median**	**Upper 10%**
Average out-of-pocket cost per accident (for HSR model), th	Skewed Bell	110.000	140.000	180.000
		Lower 10%	**Median**	**Upper 10%**
Value of time for auto travel, $ / hr	Skewed Bell	9.36000	10.4000	11.4400
		Lower 10%	**Median**	**Upper 10%**
Value of truck driver time, $ / hr	Skewed Bell	16.2540	18.0600	19.8660
		Lower 10%	**Median**	**Upper 10%**
Cost of HC emissions, thous $ / ton	Skewed Bell	1.13000	2.04000	2.96000
		Lower 10%	**Median**	**Upper 10%**
Cost of NOX emissions, thous $ / ton	Skewed Bell	1.64000	2.76500	3.89000
		Lower 10%	**Median**	**Upper 10%**
Cost of CO emissions, thous $ /ton	Skewed Bell	0.0215000	0.0500000	0.107400
			Fixed Value	
Base year gasoline fuel cost, $ / gal	Fixed Value		1.59000	
			Fixed Value	
Base year diesel fuel cost, $ / gal	Fixed Value		1.43400	
			Fixed Value	
Base year oil cost, $ / qt	Fixed Value		3.76000	
		Lower 10%	**Median**	**Upper 10%**
% additional local benefits, %	Skewed Bell	3.00000	5.00000	7.00000
Price Inflation				
		Lower 10%	**Median**	**Upper 10%**
Fuel price inflation, year 2000, %	Skewed Bell	1.76000	3.00000	4.04000

STRONG RAIL GROWTH SCENARIO DATA

Variable Description	Prob. Distribution Type	Lower 10%	Median	Upper 10%
Fuel price inflation, year 2001, %	Skewed Bell	1.72000	3.00000	4.08000
Fuel price inflation, year 2002, %	Skewed Bell	1.69000	3.00000	4.12000
Fuel price inflation, year 2003, %	Skewed Bell	1.66000	3.00000	4.16000
Fuel price inflation, year 2004, %	Skewed Bell	1.63000	3.00000	4.20000
Fuel price inflation, year 2005, %	Skewed Bell	1.60000	3.00000	4.24000
Fuel price inflation, year 2006, %	Skewed Bell	1.57000	3.00000	4.28000
Fuel price inflation, year 2007, %	Skewed Bell	1.54000	3.00000	4.32000
Fuel price inflation, year 2008, %	Skewed Bell	1.51000	3.00000	4.36000
Fuel price inflation, year 2009, %	Skewed Bell	1.48000	3.00000	4.40000
Fuel price inflation, year 2010, %	Skewed Bell	1.45000	3.00000	4.44000
Fuel price inflation, year 2011, %	Skewed Bell	1.42000	3.00000	4.48000
Fuel price inflation, year 2012, %	Skewed Bell	1.39000	3.00000	4.52000
Fuel price inflation, year 2013, %	Skewed Bell	1.36000	3.00000	4.57000
Fuel price inflation, year 2014, %	Skewed Bell	1.33000	3.00000	4.62000
Fuel price inflation, year 2015, %	Skewed Bell	1.30000	3.00000	4.67000
Fuel price inflation, year 2016, %	Skewed Bell	1.27000	3.00000	4.72000
Fuel price inflation, year 2017, %	Skewed Bell	1.24000	3.00000	4.77000
Fuel price inflation, year 2018, %	Skewed Bell	1.22000	3.00000	4.82000
Fuel price inflation, year 2019, %	Skewed Bell	1.20000	3.00000	4.87000

STRONG RAIL GROWTH SCENARIO DATA

Variable Description	Prob. Distribution Type	Lower 10%	Median	Upper 10%
General price inflation, year 2000, %	Skewed Bell	2.20000	3.00000	3.50000
General price inflation, year 2001, %	Skewed Bell	2.00000	3.00000	3.70000
General price inflation, year 2002, %	Skewed Bell	1.80000	3.00000	3.80000
General price inflation, year 2003, %	Skewed Bell	1.50000	3.00000	3.90000
General price inflation, year 2004, %	Skewed Bell	1.40000	2.50000	4.00000
General price inflation, year 2005, %	Skewed Bell	1.30000	2.50000	4.10000
General price inflation, year 2006, %	Skewed Bell	1.20000	2.50000	4.20000
General price inflation, year 2007, %	Skewed Bell	1.10000	2.50000	4.30000
General price inflation, year 2008, %	Skewed Bell	1.10000	2.50000	4.40000
General price inflation, year 2009, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2010, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2011, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2012, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2013, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2014, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2015, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2016, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2017, %	Skewed Bell	1.00000	2.50000	4.50000
General price inflation, year 2018, %	Skewed Bell	1.00000	2.50000	4.50000

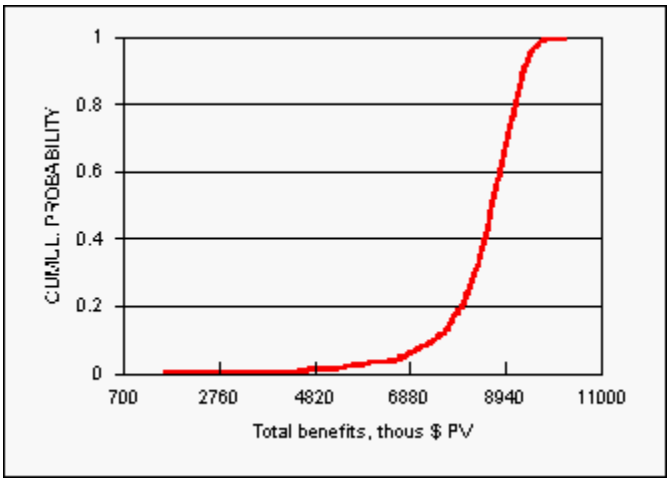
STRONG RAIL GROWTH SCENARIO DATA

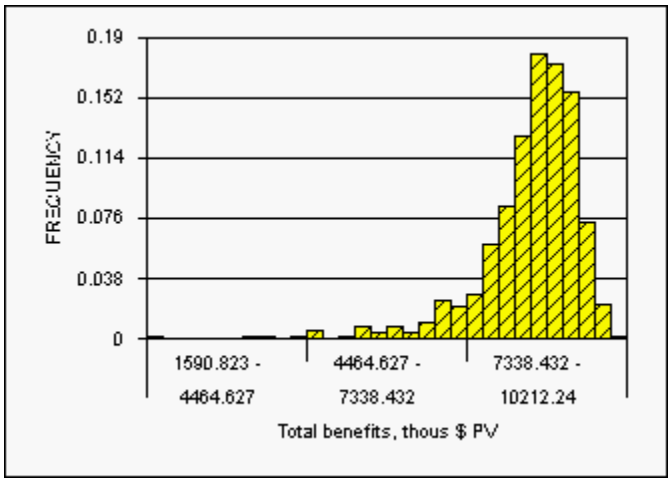
Variable Description	Prob. Distribution Type	Lower 10%	Median	Upper 10%
General price inflation, year 2019, %	Skewed Bell	1.00000	2.50000	4.50000

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC 2000 - RISK ANALYSIS OF RESULT **Total benefits, thous $ PV**

Results file:	Res11	**Scenario ID:**	1
File description:	Rail growth, Empire South HSR	**Scenario Description:**	Strong rail growth
Corridor ID:	3	**Number of Trials:**	501
Corridor:	Empire South	**Date/Time of Simulation:**	11/15/00 8:10:17 AM





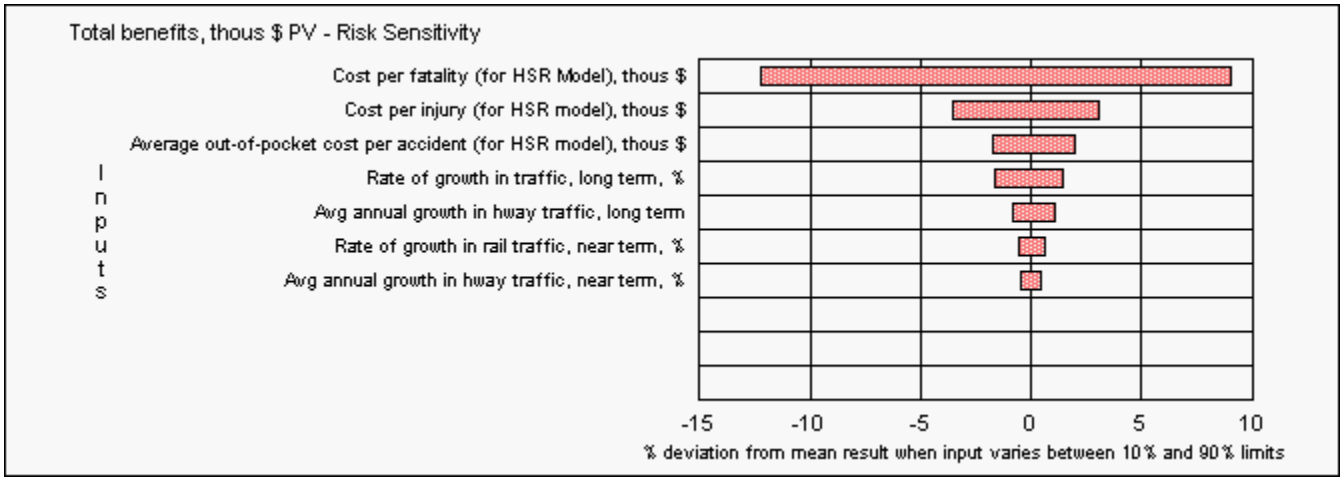
Summary Statistics
Total benefits, thous $ PV

Mean	**8,463.47**
Standard Deviation	970.079
Minimum	1,590.82
Maximum	10,212.2
Skewness	-2.32543
Kurtosis	8.86176

Percentile Summary
Total benefits, thous $ PV

1%	4,667.53
5%	6,781.33
10%	7,407.35
20%	8,007.97
30%	8,282.90
40%	8,509.89
50%	8,648.46
60%	8,832.50
70%	8,989.79
80%	9,168.88
90%	9,345.61
95%	9,474.78
99%	9,738.50

80% CONFIDENCE



FEDERAL RAILROAD ADMINISTRATION

GRADEDEC 2000 - RISK ANALYSIS RESULTS

Results file: Res11.mdb
Rail growth, Empire South HSR
Corridor: 3
Empire South
Scenario: 1
Strong rail growth

Number of Trials: 501
Random Seed: 1
Date/Time of Simulation: 11/15/00 8:10:17 AM

Result No.:	Result Variable Description	Percentile Summary						Summary Statistics			
1	***Safety benefits, thous $ PV***										
		1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
		3,792	*5,513*	*6,022*	*6,511*	*6,734*	*6,919*	6,881	789.4	-2.326	8.868
	50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
	7,031	*7,181*	*7,309*	*7,455*	*7,599*	*7,703*	*7,917*	1,287		8,302	
2	***Travel time savings, thous $ PV***										
		1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
		4.957	*5.224*	*5.402*	*5.673*	*5.810*	*5.959*	6.137	0.5739	0.2738	0.0208
	50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
	6.115	*6.280*	*6.422*	*6.581*	*6.904*	*7.143*	*7.526*	4.689		8.013	
3	***Environmental benefits, thous $ PV***										
		1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
		0.0140	*0.0175*	*0.0209*	*0.0233*	*0.0256*	*0.0273*	0.0291	0.0070	0.3807	0.5759
	50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
	0.0290	*0.0305*	*0.0321*	*0.0343*	*0.0379*	*0.0417*	*0.0480*	0.0111		0.0577	
4	***Veh operating cost benefit, thous $ PV***										
		1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
		0.2110	*0.2190*	*0.2233*	*0.2281*	*0.2331*	*0.2369*	0.2411	0.0148	0.6838	1.723
	50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
	0.2405	*0.2436*	*0.2472*	*0.2526*	*0.2597*	*0.2660*	*0.2794*	0.2055		0.3223	
5	***Network benefits, thous $ PV***										
		1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0	0.0	0.0	-3.000
	50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0		0.0	
6	***Total benefits, thous $ PV***										
		1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
		4,668	*6,781*	*7,407*	*8,008*	*8,283*	*8,510*	8,463	970.1	-2.325	8.862
	50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
	8,648	*8,833*	*8,990*	*9,169*	*9,346*	*9,475*	*9,739*	1,591		10,212	

Result No.:	Result Variable Description	Percentile Summary					Summary Statistics			
7	***of this, benefits from induced trips, thous $ PV***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	870.5	*1,264*	*1,381*	*1,492*	*1,543*	*1,585*	1,577	180.6	-2.323	8.852
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
1,611	*1,646*	*1,674*	*1,708*	*1,741*	*1,765*	*1,815*		297.6		1,904
8	***of this, disbenefits from induced trips, thous $ PV***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	-1.439	*-1.190*	*-1.092*	*-0.9777*	*-0.9024*	*-0.8556*	-0.8179	0.2141	-0.5221	1.056
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
-0.8073	*-0.7597*	*-0.7116*	*-0.6445*	*-0.5678*	*-0.4878*	*-0.3613*		-1.758		-0.2297
9	***Total costs, thous $ PV***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	2,260	*2,260*	*2,260*	*2,260*	*2,260*	*2,260*	2,260	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
2,260	*2,260*	*2,260*	*2,260*	*2,260*	*2,260*	*2,260*		2,260		2,260
10	***Net benefits, thous $ PV***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	2,407	*4,521*	*5,147*	*5,748*	*6,023*	*6,250*	6,203	970.1	-2.325	8.862
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
6,388	*6,572*	*6,729*	*6,909*	*7,085*	*7,214*	*7,478*		-669.5		7,952
11	***Benefit-cost ratio***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	2.065	*3.000*	*3.277*	*3.543*	*3.664*	*3.765*	3.744	0.4292	-2.325	8.862
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
3.826	*3.908*	*3.977*	*4.056*	*4.135*	*4.192*	*4.308*		0.7038		4.518
12	***Rate of return (constant dollars), %***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	16.51	*26.08*	*29.22*	*32.07*	*33.67*	*34.78*	34.63	4.778	-2.181	7.989
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
35.60	*36.47*	*37.39*	*38.07*	*39.18*	*39.95*	*41.06*		1.088		42.08
13	***Local benefits (not included in summary), thous $ PV***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	95.50	*197.8*	*245.9*	*306.9*	*349.4*	*387.2*	422.9	139.9	0.0660	-0.0804
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**
416.6	*450.1*	*491.5*	*545.9*	*608.8*	*643.1*	*755.9*		23.44		837.9

Result No.:	Result Variable Description	Percentile Summary					Summary Statistics			
14	***Safety Benefit, GCX 1, thous $ PV, MP 46.04***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	506.1	*735.6*	*802.7*	*868.8*	*898.8*	*920.5*	917.7	104.9	-2.343	8.944
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
938.5	*957.8*	*974.5*	*993.2*	*1,013*	*1,028*	*1,057*	172.9		1,099	
15	***Safety Benefit, GCX 2, thous $ PV, MP 47.4***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	260.1	*377.4*	*413.0*	*445.7*	*461.4*	*474.0*	471.7	54.22	-2.306	8.775
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
481.9	*492.3*	*500.9*	*510.8*	*520.3*	*528.9*	*542.6*	88.51		573.1	
16	***Safety Benefit, GCX 3, thous $ PV, MP 62.55***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	768.0	*1,116*	*1,218*	*1,318*	*1,364*	*1,397*	1,392	159.2	-2.343	8.944
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
1,424	*1,453*	*1,479*	*1,507*	*1,537*	*1,560*	*1,603*	262.3		1,667	
17	***Safety Benefit, GCX 4, thous $ PV, MP 71***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	1,895	*2,752*	*3,013*	*3,252*	*3,366*	*3,457*	3,441	395.9	-2.312	8.805
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
3,516	*3,592*	*3,656*	*3,725*	*3,798*	*3,857*	*3,960*	640.4		4,174	
18	***Safety Benefit, GCX 5, thous $ PV, MP 75.95***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	362.5	*527.3*	*575.5*	*622.9*	*644.5*	*660.2*	657.9	75.32	-2.346	8.957
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
673.0	*686.5*	*699.0*	*712.2*	*726.4*	*737.1*	*757.1*	122.9		787.7	
19	***Travel Time Savings, GCX 1, thous $ PV, MP 46.04***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0		0.0	
20	***Travel Time Savings, GCX 2, thous $ PV, MP 47.4***									
	1%	***5%***	***10%***	***20%***	***30%***	***40%***	**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***	**Minimum**		**Maximum**	
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0		0.0	

Result No.:	Result Variable Description	Percentile Summary						Summary Statistics			
21	***Travel Time Savings, GCX 3, thous $ PV, MP 62.55***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	4.948	*5.215*	*5.393*	*5.663*	*5.800*	*5.948*		6.126	0.5729	0.2738	0.0208
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
6.104	*6.269*	*6.411*	*6.569*	*6.892*	*7.131*	*7.513*		4.681		7.999	
22	***Travel Time Savings, GCX 4, thous $ PV, MP 71***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0087	*0.0092*	*0.0095*	*0.0099*	*0.0102*	*0.0104*		0.0107	0.0010	0.2695	0.0149
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
0.0107	*0.0110*	*0.0112*	*0.0115*	*0.0121*	*0.0125*	*0.0132*		0.0082		0.0140	
23	***Travel Time Savings, GCX 5, thous $ PV, MP 75.95***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0		0.0	
24	***Environmental Benefit, GCX 1, thous $ PV, MP 46.04***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0		0.0	
25	***Environmental Benefit, GCX 2, thous $ PV, MP 47.4***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0		0.0	
26	***Environmental Benefit, GCX 3, thous $ PV, MP 62.55***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0139	*0.0175*	*0.0209*	*0.0233*	*0.0256*	*0.0273*		0.0291	0.0070	0.3807	0.5759
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
0.0289	*0.0304*	*0.0320*	*0.0342*	*0.0379*	*0.0416*	*0.0479*		0.0110		0.0576	
27	***Environmental Benefit, GCX 4, thous $ PV, MP 71***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.3790	0.5716
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0		0.0001	

Result No.:	Result Variable Description	Percentile Summary						Summary Statistics			
28	***Environmental Benefit, GCX 5, thous $ PV, MP 75.95***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
29	***Benefit Veh Op Cost, GCX 1, thous $ PV, MP 46.04***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
30	***Benefit Veh Op Cost, GCX 2, thous $ PV, MP 47.4***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
31	***Benefit Veh Op Cost, GCX 3, thous $ PV, MP 62.55***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.2107	*0.2186*	*0.2229*	*0.2277*	*0.2327*	*0.2365*		0.2406	0.0148	0.6838	1.723
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.2401	*0.2432*	*0.2468*	*0.2521*	*0.2592*	*0.2656*	*0.2789*			0.2051		0.3218
32	***Benefit Veh Op Cost, GCX 4, thous $ PV, MP 71***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0004	*0.0004*	*0.0004*	*0.0004*	*0.0004*	*0.0004*		0.0004	0.0	0.6914	1.766
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0004	*0.0004*	*0.0004*	*0.0004*	*0.0005*	*0.0005*	*0.0005*			0.0004		0.0006
33	***Benefit Veh Op Cost, GCX 5, thous $ PV, MP 75.95***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
34	***Network Benefits, GCX 1, thous $ PV, MP 46.04***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0

Result No.:	Result Variable Description	Percentile Summary						Summary Statistics			
35	***Network Benefits, GCX 2, thous $ PV, MP 47.4***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
36	***Network Benefits, GCX 3, thous $ PV, MP 62.55***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
37	***Network Benefits, GCX 4, thous $ PV, MP 71***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
38	***Network Benefits, GCX 5, thous $ PV, MP 75.95***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*		0.0	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			0.0		0.0
39	***Total Benefits, GCX 1, thous $ PV, MP 46.04***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	506.1	*735.6*	*802.7*	*868.8*	*898.8*	*920.5*		917.7	104.9	-2.343	8.944
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
938.5	*957.8*	*974.5*	*993.2*	*1,013*	*1,028*	*1,057*			172.9		1,099
40	***Total Benefits, GCX 2, thous $ PV, MP 47.4***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	260.1	*377.4*	*413.0*	*445.7*	*461.4*	*474.0*		471.7	54.22	-2.306	8.775
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
481.9	*492.3*	*500.9*	*510.8*	*520.3*	*528.9*	*542.6*			88.51		573.1
41	***Total Benefits, GCX 3, thous $ PV, MP 62.55***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	774.0	*1,123*	*1,225*	*1,325*	*1,370*	*1,403*		1,399	159.2	-2.341	8.925
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***			**Minimum**		**Maximum**
1,430	*1,459*	*1,484*	*1,513*	*1,544*	*1,567*	*1,609*			269.4		1,675

Result No.:	Result Variable Description	Percentile Summary						Summary Statistics			
42	***Total Benefits, GCX 4, thous $ PV, MP 71***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	1,895	*2,752*	*3,013*	*3,252*	*3,366*	*3,457*		3,441	395.9	-2.312	8.805
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
3,516	*3,592*	*3,656*	*3,725*	*3,798*	*3,857*	*3,960*		640.4		4,174	
43	***Total Benefits, GCX 5, thous $ PV, MP 75.95***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	362.5	*527.3*	*575.5*	*622.9*	*644.5*	*660.2*		657.9	75.32	-2.346	8.957
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
673.0	*686.5*	*699.0*	*712.2*	*726.4*	*737.1*	*757.1*		122.9		787.7	
44	***Total Costs, GCX 1, thous $ PV, MP 46.04***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	162.8	*162.8*	*162.8*	*162.8*	*162.8*	*162.8*		162.8	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
162.8	*162.8*	*162.8*	*162.8*	*162.8*	*162.8*	*162.8*		162.8		162.8	
45	***Total Costs, GCX 2, thous $ PV, MP 47.4***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	192.9	*192.9*	*192.9*	*192.9*	*192.9*	*192.9*		192.9	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
192.9	*192.9*	*192.9*	*192.9*	*192.9*	*192.9*	*192.9*		192.9		192.9	
46	***Total Costs, GCX 3, thous $ PV, MP 62.55***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	1,549	*1,549*	*1,549*	*1,549*	*1,549*	*1,549*		1,549	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
1,549	*1,549*	*1,549*	*1,549*	*1,549*	*1,549*	*1,549*		1,549		1,549	
47	***Total Costs, GCX 4, thous $ PV, MP 71***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	192.9	*192.9*	*192.9*	*192.9*	*192.9*	*192.9*		192.9	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
192.9	*192.9*	*192.9*	*192.9*	*192.9*	*192.9*	*192.9*		192.9		192.9	
48	***Total Costs, GCX 5, thous $ PV, MP 75.95***										
	1%	***5%***	***10%***	***20%***	***30%***	***40%***		**Mean**	**Std Dev**	**Skewness**	**Kurtosis**
	162.8	*162.8*	*162.8*	*162.8*	*162.8*	*162.8*		162.8	0.0	0.0	-3.000
50%	***60%***	***70%***	***80%***	***90%***	***95%***	***99%***		**Minimum**		**Maximum**	
162.8	*162.8*	*162.8*	*162.8*	*162.8*	*162.8*	*162.8*		162.8		162.8	